THE BOOK OF SCHOOL HANDWORK


E. TURNER

THE BOOK OF SCHOOL HANDWORK

AN ENCYCLOPÆDIA OF EDUCATIONAL HANDWORK SUBJECTS, METHODS, MATERIALS, TOOLS, ORGANISATION ETC.

Written by the Leading Authorities on, and Leading Teachers of, Handwork in the British Isles

EDITED BY

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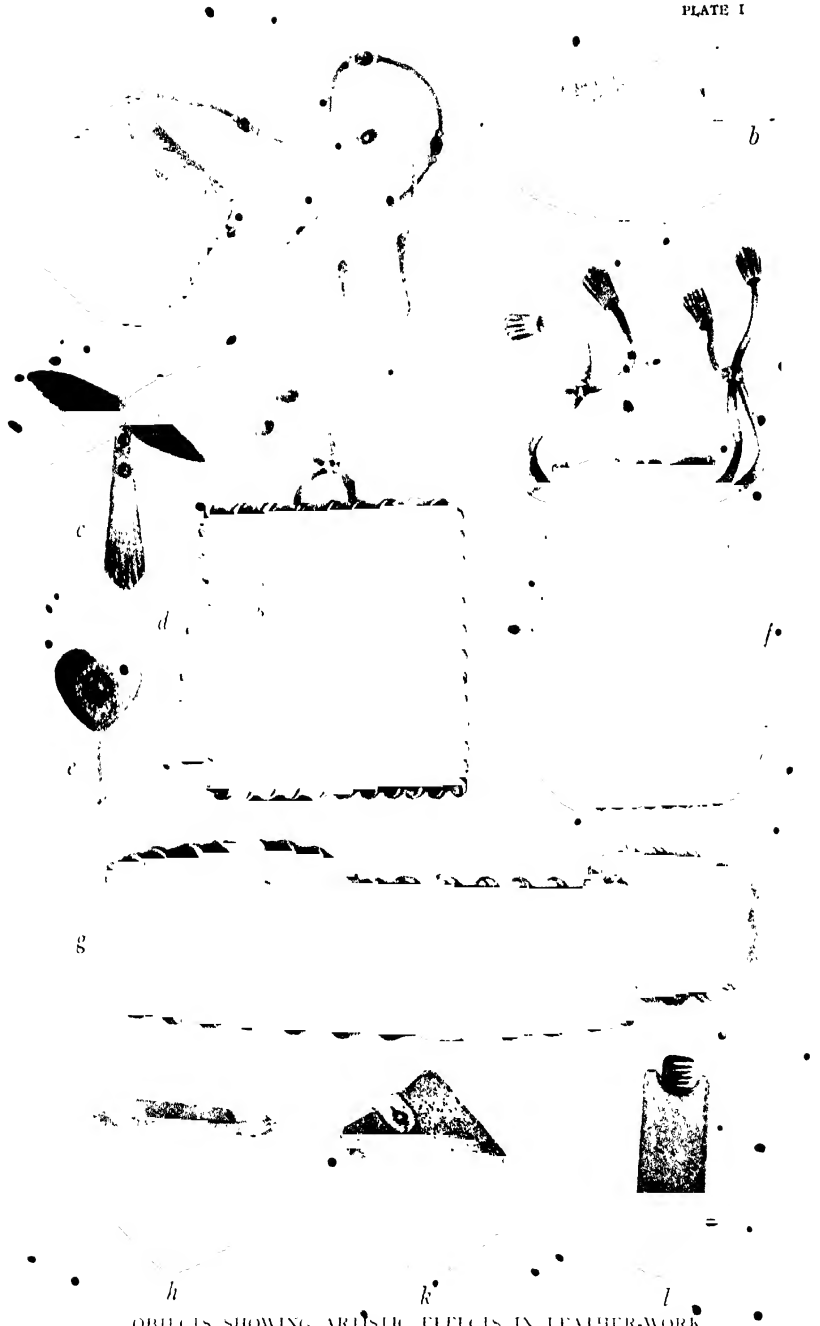

OBJECTS SHOWING ARTISTIC EFFECTS IN LEATHER-WORK

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LII. LEATHER WORK

By MRS. H. M. SWINBURNE

Late Headmistress A'court Street Special School, Nottingham; Superintendent Hopwell Hall, Derbyshire; Associate Nottingham Society of Artists; Author of "Rainbow Laths."

Its Educational Value.—Children work in wool, linen, calico, etc., why not in leather? There seems to be no reason except that it would be quite unusual and altogether out of the beaten track. That is one point, though perhaps not a very important one, in its favour. It might be urged against it that the material is too expensive; but this is not so, as the prices of leather given at the end of this article will show. Sheepskin is cheaper than any other leather, and it is work in this leather that is specially recommended.

The following are a few points in favour of this form of handwork: (*a*) It is an entire change from ordinary materials used in school handwork. (*b*) Leather, being one of the most beautiful materials in which to work, inspires the children to put forth their best efforts. (*c*) It has a subtle fascination possessed by few other materials; the softness and suppleness of the texture appeal to children, and when once they have handled a skin they are held by a new and absorbing interest. (*d*) Harmony of colour is taught; the soft shades of the leather have a marked effect on the children, so that in time they turn instinctively from a faulty combination of colour. (*e*) There is distinct purpose at the back of this occupation, and the natural craving to make something

beautiful and at the same time useful is satisfied. (*f*) It demands resourcefulness, carefulness in detail, and accuracy in workmanship. (*g*) It provides a wide scope for individuality.

Its History.—Leather comes to us from the most primitive times. We know that the really important place in the wardrobes of our early ancestors was filled by skins shorn of hair. In all ages man has sought to develop the possibilities of splendour in the materials of his dress, so he would soon find the means for decorating the bare skins. The Crusaders brought back with them to Europe leather ornamented with wool, silk, and precious metals. Europe soon set itself to imitate this art of working in leather, and found a source of faultless taste in Spain, then occupied by the Moors.

Modelled and stamped leather had, about the same time, been introduced from the East into Venice; other countries, too, were soon doing good work, as those marvels of carved and embossed leather seen in the British Museum and other places prove. In the Middle Ages leather bindings carved and modelled in heraldic designs took their places as coverings for the beautiful manuscript work of the Monks.

Such coverings were soon found to be more lasting than those formerly used; so that down to the present time leather has been unrivalled as a covering for books. In mediæval times much value was set upon this excellent and durable material not only for articles of dress, but for hangings and coverings in the homes of the well-to-do.

Different Methods of Decorating Leather.—There are numerous varieties of leather work. Some of the usual forms are as follows: Carved leather; punched or hammered leather; modelled leather; modelled leather with punched background; leather decorated by pyrogravure; stamped leather; open-work leather; leather mosaic. Some of these are beyond the scope of this article, and only the simpler forms will be described here. When simplicity of design and good workmanship are combined, the result is satisfying. These are the forms of leather work recommended for schools:—Mexican or thonged; incised; appliqué; punched or hammered; leather work with bead work and metal work; and leather work as applied to articles of dress and in the home.

Mexican or Thonged Leather.—This is very easily manipulated. The leather used is sheepskin, and is known by leather-workers as "Velvet Persian." Dressed on what is called the flesh side, it has a most delightful velvety surface, with quite a "nap" almost like plush.

One important feature of "Mexican" work is that the articles are "thonged"; not sewn with silk, thread, or other foreign substance, but put together with thongs—*i.e.* strips of leather; so that one may say that it is entirely leather. These thongs are cut very narrow and threaded or laced through holes, which have first been punched at regular intervals of about ¼ in. Fig 1 shows the kind of punch used. It is almost like a pair of pliers, and the small steel punches which can be had in various sizes are screwed into the screw-hole at the end. The thonging can be done in two different ways, the more effective being to thong over the edges like over-sewing (Fig. 6*a*). The second way is like the running stitch in sewing (Fig. 6*b*).

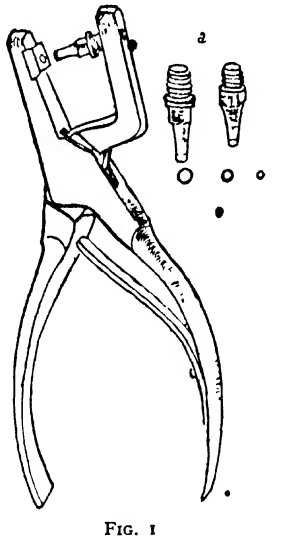


FIG. 1

A large number of beautiful and useful articles can be made in this kind of leather work such as bags and wallets of various shapes and sizes; articles of dress, as belts, hats, muffs, stoles, Peter Pan collars, ties, bows, gaiters, waistcoats, jackets, etc., handsome cushion covers, and pipe-racks, blotters, pocket-books, purses, etc.

Beads often play an important part in the decoration of this form of leather work. The writer introduces a simple form of metal work, generally copper or pewter, with very pleasing result, as a decoration in Mexican work.

Cut or Incised Work is generally done on stouter leather, such as calf-skin or cow-hide. The design is cut into the leather with a sharp-pointed knife to about one-third of the thickness of the material, and the incision is afterwards accentuated with a tool called an "opener" (see Fig. 2*b*). This form of leather

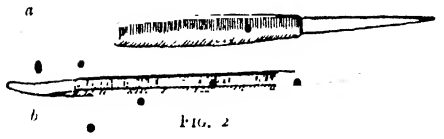


FIG. 2

work is suitable for older boys and girls; but a simpler form of incised work, taken in conjunction with *Appliquéd Leather* and worked in the soft Velvet Persian skins, is very effective and yet not too difficult for younger children.

The design should be bold and simple in outline. Let the children trace it first on stiff paper, then cut it out and press it firmly on the smooth velvet side of the skin. When the cut-out pattern is carefully lifted up, a distinct impression of the design remains on the leather. This design is now cut out with a sharp pair of pointed scissors, care being taken not to obliterate the impressed design while working. It is well to hold the scissors slantwise in order to make a bevelled edge, so that the underside of the leather does not show. A shoemaker's knife may be employed or a sharp penknife, but it is better and easier for children to use scissors.

For a first attempt some simple geometric pattern, made by paper-folding or otherwise, might be tried, but later the children will enjoy making their own designs. Grotesque birds and beasts look well, and give a quaint touch to the work (Plate I, D). The cut-out design is pasted on the underside and firmly pressed on to the leather which is to be decorated.

The following recipe for paste cannot be improved upon: Place half a quartern of flour in a saucepan, put as much cold water as will cover it, and stir up well so as to break all the lumps while in a state of dough. Then pour on about two quarts of cold water and one ounce powdered alum. Stir well and boil until it becomes quite thick. Mendine or Le Page's Liquid Cement are also excellent for the purpose.

Incised and appliquéd leather can be used to decorate silk, satin, or other material; bags, mats, pincushions, cushion covers, collars, cuffs, etc., look well ornamented in this style of leather work.

Punched or Hammered Work is generally done in calf-skin or cow-hide, but it can be quite as well done in a cheaper leather called basil, which is really sheepskin dressed on the outer side

of the skin—the opposite side to that of Velvet Persian. Leather decorated entirely by means of punches is called hammered leather. Punched work is often used in conjunction with modelled leather or carved leather, and with great advantage, as the punched background heightens the effect of the relief.

The punches used are steel or brass with the design cut at the point either in relief or in intaglio. If steel punches are used, they must be kept bright and clean, or a bluish mark is sometimes made by them on the leather when damp. The punches can either be pressed on the leather by the hand alone, or tapped smartly with a small hammer. For hand pressure only they should be fixed in wooden handles to afford greater grip and power. They may be used hot, and this darkens the punch mark on the leather. A few designs for punches are given in Fig. 3, but some good effects are obtained by using, as a punch, the blunt point of an iron nail.

FIG. 3

An excellent effect is gained by varnishing the punched background and painting it over with bronze, gold, or silver powder.

The method of preparing and tracing the design on the material is the same whether the work is to be done in basil, calf-skin, cow-hide, or velvet cow-hide. The last-named is cow-hide dressed on the flesh side, and has a soft texture.

Before commencing work the leather is made thoroughly damp with a sponge slightly moistened in cold water. It is necessary to damp the *entire surface* of the leather, and not simply that part where the design is to appear, as in the latter case a distinct halo would be formed round the work. When the leather has once been damped, certain parts may be moistened without doing any harm. The degree of dampness can be judged accurately by practice. Generally speaking, the moisture should have penetrated the leather so that the pressure of the tool will not bring it back to the surface.

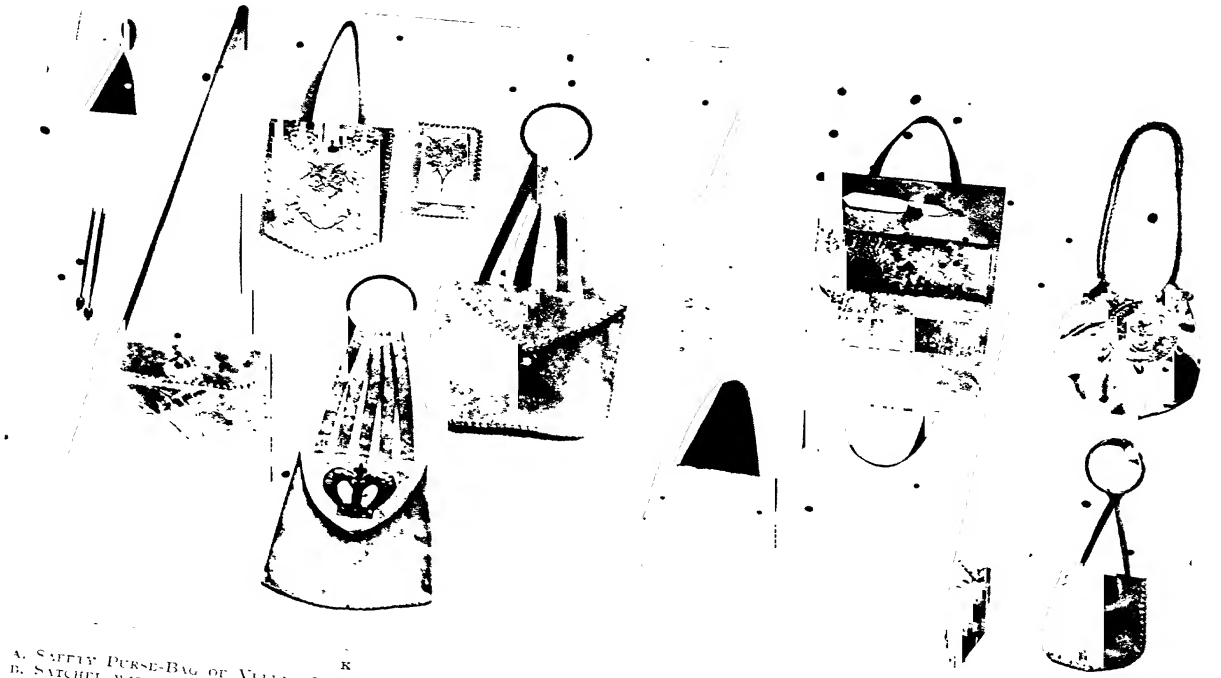
The operation of tracing the design is common to all kinds of

the usual forms of leather work. The design should first be drawn on thick tracing paper, or, better still, tracing *linen*. This is then fixed in place, so that it does not move during the transfer of the design. A good way is to let the children fold over the edge of the tracing to the back of the leather and fix it with a little adhesive substance. The leather must previously be made damp, so that it takes the impression of the tracing easily. Take the steel tracer or outlining tool, and, using it as one uses a lead pencil, go over every line of the design with a firm, even pressure, such as will ensure a clear indentation on the surface of the leather.

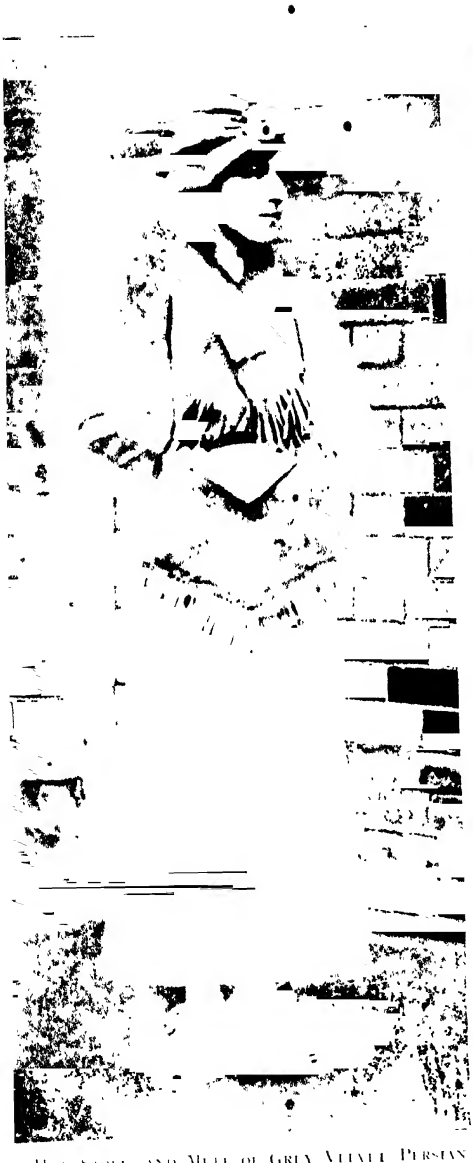
The outline should be dark; if lighter than the leather, it is a proof that it requires moistening again. One should avoid going over a line twice, and the children may be allowed to raise the tracing occasionally, but also very carefully, "just to see how the work is coming on," and whether the design is being well defined. Should the line be faint, it is a proof that either the pressure on the tracing point is insufficient or that the leather requires more moistening. It is usual to work on a slab of marble or stone, or even thick glass, but a hard drawing board or the table alone will do quite as well.

When the design has been transferred to the leather, the background may be punched, to throw the design into relief. It is as well to let the children first practise punching on a few spare bits of leather. The punch should be held quite upright, and a firm, gentle tap from a small hammer should be given it, flat on the head; for if the stroke is not true a bad impression is made. Hand and eye are finely trained by this punching.

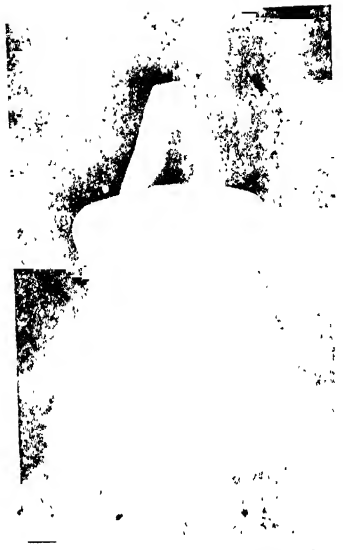
It is a good plan to start punching round the outline of the design, because this requires carefulness on the part of the worker, as the punch *must not overstep* the outline though going close to it. The punch marks need not go in any regular order, but an all-over effect should be aimed at; and they may even overlap each other so as to cover the ground well. Another way is to punch close round and about the design, and gradually let the punching die away into the distance around. An ornamental border may be designed by placing certain punches in various positions (see Fig. 4) so as to form a pattern. It is well to



A. Safety Purse-Bag of Velvet Persian
B. Satchel with Gusset of Stained and Punched Basil
C. D. Sunday Bag and Book of Punched Basil
E. K. Safety Wallets of Velvet Persian with Copper Mounts and Rings
F. Sunday Bag of Velvet Calf-skin Appliquéd with Leather
G. Book-carrier of tan-coloured Morocco
H. Bag of Dull Golden Skiver with Plaited Leather Drawstring. The Bag is Lined in Pieces of Stained and Punched Calf-skin
I. Grey Calf-skin Velvet Bag
J. Necktie of Velvet Persian
N. Purse-Bag of Natural-coloured Basil with Rattan Ring



A. Hat, Stole, and Muff of Grey Velvet Persian. The Muff has a Plaited Leather Chain with Tassels, and an Oxidised Copper Mount on the Flap of the Pocket.



B. Dark Green Morocco Market-Bag.

C. Leather Hat Ornamented with Feathers made of Leather.

remember that punching or hammering leather has the effect of strengthening it.

This work is suitable for decorating book covers, book carriers, note-books, blotters, etc. Plate II, c, d, show a Sunday bag with book, both made of basil, and decorated with hammered work. Another variation would be to stain the design and leave the background the natural colour or vice versa. If the work is left its natural colour, it has a delightfully soft shade, as of old ivory, which is most satisfying.

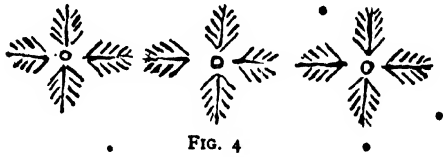


FIG. 4

Leather Work with Bead Work, etc.—This is a most effective combination. At various missionary exhibitions one may often see soft leather articles worked by the South Sea Islanders and other tribes in patterns of tiny coloured beads. Very intricate designs, too, are worked in porcupine quill split into threads, and even with the sinews of wild animals. At a recent exhibition of this kind a leathern saddle was shown worked all over with an elaborate design of small brightly coloured beads; also there were mocassins, caps, bags, gloves, and even trousers worked in the same way.

In decorating soft leather with beads it is a good plan to have the latter threaded on strong thread to match the leather in colour. Place the string of beads on the pattern, and stitch the thread down to the leather between the beads at close intervals.

It is well in making various articles to begin with the most simple forms, and work in Velvet Persian, because it is so easily worked. Do not take a very small article (*e.g.* a pen-wiper or a small mat) upon which to make a start, since it is often more easy to work with a larger piece, which gives more scope. Ask the children what they would like to make, and the greater number are likely to say a bag. Let them make a bag of the most simple kind.

A Simple Bag.—This is made of an oblong piece of leather doubled over so that the two lower corners meet the two upper ones, thus leaving only the left and right edges to be joined. In folding over let the velvet side be inside until the holes are

punched, so that unnecessary marks on the leather are avoided.

First let the children try in brown paper as follows: Measure and cut off a piece 7 in. × 18 in.; fold over (they will see the shape of the bag); open out this pattern and lay it on the velvet side of the leather, pressing it well down, especially round the four edges, so as to imprint the lines upon the leather; then cut along these lines, and there is the oblong for the bag.

See that the scissors are sharp, not necessarily sharply pointed, for this work; and also see that they are held slantwise, so that the under side of the skin is not shown at the edges. Encourage the children to suggest how the sides of the bag may be joined. It is not a good plan to tell them, for they may astonish one with quite original suggestions. The following plan may possibly be thought of by some. Punch holes along the sides, and lace a strip of leather or a thong through these holes, thus closing up the sides.

In the first bag we made the holes were pierced with a bradawl and hammer, but they can be made more quickly and easily by using the punch. It would be well to allow some practice in punching holes at *regular* intervals in a *straight* line on the paper pattern; for here, as in everything else, a little practice soon makes perfect. Screw a No. 4 punch into the steel punch-holder or punch-pliers, and, after folding over the leather to the shape of the bag, proceed to punch the holes through the double thickness of leather. To keep the edges together and in place, fasten them with a clip at each end and one in the middle (see Fig. 5).

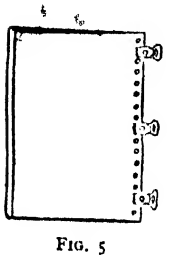
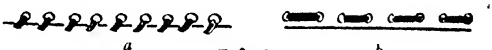


FIG. 5

It sometimes happens that the punch does not "bite" through the under piece of leather. To rectify this, place an odd bit of leather or stiff piece of paper at the back and punch through the three thicknesses. This will be found effective. It is a matter of taste how far apart or how far from the edge these holes should be punched, but ¼ in. apart and ⅛ in. from the edge is about right in this instance. When the punching is completed up the right and left side of the oblong, turn it right side out

and cut the narrow thongs which are threaded through these holes to fasten up the sides. Two strips are needed, about 14 in. long and ⅛ in. wide. Let them be pointed at one end, so that they thread through easily; make a knot, or a double one will be better, about 3 in. from the other end; tap the knot smartly with the hammer to make it hard and firm; begin to lace the sides together at the lower right-hand corner, passing the pointed end through the first hole on the front, and bringing it out first hole on the back; and see that the knot sits nicely, as it is a feature in the decoration of the bag, since the shiny side of the leather is shown in the lacing.

Proceed with the "thonging" down one hole and up the next like the "running" stitch in sewing (see Fig. 6*b*). And, as in "running," the thong must not be drawn too tightly or a puckered appearance will result. When the top edge of the bag is reached, make a firm double knot to fasten off the thong. After both edges are thonged, draw attention to the tail ends right and left, and ask what is to be done with them. Beads may be threaded, several of them with knots between (Fig. 7), or one large wooden bead with a knot at the end, and the tail end may be split in two and beads threaded on both, thus making a pretty tassel. The writer uses all kinds of things for decorating the ends of thongs in this way—even the wooden moulds out of a frayed and worn umbrella tassel come in useful when stained or bronzed.



a FIG. 6 *b*

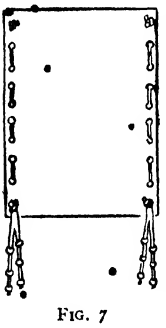


FIG. 7

Get the children to suggest the kind of handles they would like for their bag. Here is one suggestion: Let holes be made round the top edge and thongs laced through to draw it up, and so make a "Dorothy bag." To do this the holes should be punched about 2 in. from the top and through both thicknesses of leather, in pairs one over the other and in equal numbers (see Fig. 8). Now cut downwards from one hole to the other, thus forming a slit through which the handles are threaded.

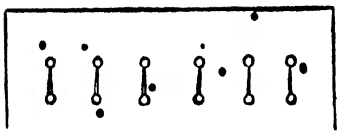


FIG. 8

For the handles cut two thongs about 24 in. long, ½ in. wide, and lace through the slits from right to left, going right round both sides of the bag; and lace from left to right with the second thong in and out of the same slits all round in the opposite direction, so that a draw-string is made. Tie each pair of ends in a firm knot about 3 in. from the tip; cut each of these ends right up to the knot; and decorate with beads to correspond with lower corners. This is an original idea for a bag which is exceedingly easy to make.

It is well to let the children choose their own colour. Suitable colours are a soft dull shade of green, reseda, grey, and browns in various shades from a rust colour to dull brown. All are charming, and it is a treat to see the children's eyes sparkle when they first deal with these lovely colours.

Another Simple Bag showing the *over*-thonging will now be described. We will suppose the measurement is to be 8 in. × 6 in. Proceed as in the previous example to cut out the pattern in stiff brown paper, but, instead of keeping the oblong shape, cut away the two lower corners (see Fig. 9) by measuring off 1 in., both vertically and horizontally, at *a* and *b*. If preferred, the sides may be shaped by measuring ½ in. from *c*, the same from *d*, and cutting in a straight line from the points to the lower corners. Follow the method described in impressing the pattern on the velvet side of the leather, and cut out the two pieces to form the bag. Punch the holes all round the edges as before, but in this instance commence 2 in. away from the top edge, leaving off the same distance from the top on the opposite edge. Cut the

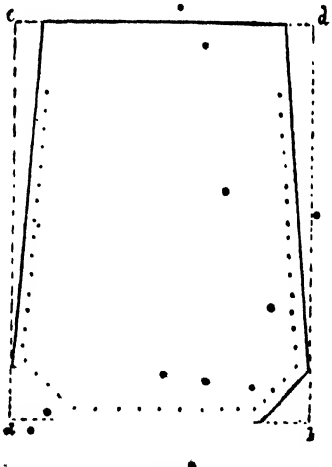


FIG. 9

thong a good length, for by so doing a join will be avoided.

In this bag we may commence thonging without a knot. Begin at the top left-hand corner by threading the thong through the first hole, but only through the top thickness of leather, leaving a tail end of about 1½ in. (see Fig. 10*a*), which must lie to the left flat between the two thicknesses of the bag and parallel to the edge, as in seaming. It is as well to place a touch of seccotine or Le Page's on this tail end before pressing it sandwich-like between the two leathers. Now thread the thong of leather over the edge through the first hole at the back, and into the first corresponding hole at the front again, thus making a very firm beginning (see Fig. 10*b*). The tail end of the thong, lying as it does parallel and between the edges and the holes, is gripped fast in the thonging as it proceeds, and cannot be seen. This is the neatest way of commencing the work.

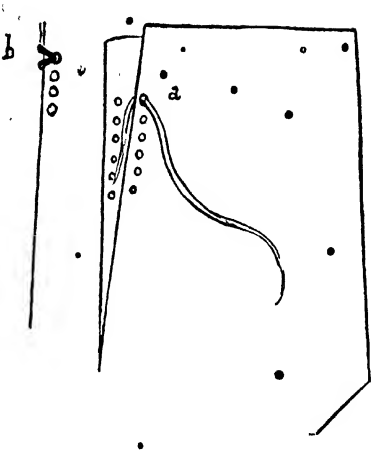


FIG. 10

Should the thong not be long enough to finish the lacing, a fresh piece must be joined, and this is done in the following manner, which is so neat that no one can point out the join. Insert the end of the new piece, previously cut fine, between the two sides of leather, letting it lie from right to left. Do this while enough of the first thong is left to thong over the new end for about four holes; then, instead of bringing the old piece through both thicknesses of leather, only bring it through the back piece, letting the end lie parallel to the edge and between the two pieces. Next thread the end of the new thong through the hole which the old thong would have come through had it been long enough, and go on thonging, keeping the end of the old thong down between the two edges. This is very easy to do, but difficult to explain.

In finishing off without a knot, thread the end of the thong

through a rug needle, and, bringing it between the two edges inside the bag, work the needle down through several stitches, drawing the thong through firmly. Of course, one has to have the bag well open, and be looking inside it, to do this. Be sure that the thong is drawn through the inside stitches very firmly, then cut the end away. It is usual to thong with the shiny, or undressed, side of the leather, which shows as a contrast to the bag. There is to be a fringed decoration to this bag, so cut two pieces of leather 2½ in. wide and of the same length as the width of the bag at the top. The long sides of both pieces are cut in narrow strips to form a fringe to within ¾ in. of the middle. When fringed, smear a little adhesive on the back, and press down firmly one piece each side of the bag, so that the top edge of the latter coincides with the edge of the fringe. These fringed pieces can be attached with either the smooth side or the velvet side showing.

The holes for the draw-strings may now be punched right through the fringed border and the top of the bag (Plate I, F). Cut the two thongs for these draw-strings and lace through the openings as described for the first bag. Instead of beads, the ends of the draw-strings may be decorated with tassels made as follows: Cut off a piece of leather 1½ in. × 1 in.; fringe it to within ¼ in. of the top edge; on this unfringed portion smear a very small quantity of adhesive on the wrong side and roll it tightly round the end of the thong (see Fig. 11). Press over the end (*a*) firmly down with adhesive, nipping it well with the fingers for a few minutes to make it keep in place. This completes the bag.

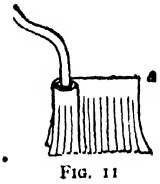


FIG. 11

A Belt.—This is another simple article. There are various kinds well within the scope of the children, but the one to be described now is very easy, and is made out of three odd pieces of leather. This is an advantage, as in the cutting up of the skin into various articles there comes a time when short pieces abound, which are not large enough for bags, etc. The width of the belt is a matter of taste, but 1½ in. is a good width, so let the children cut their paper pattern this width and about 14 in. in length, care being taken that the edges are parallel. Two pieces

of leather will be required this shape, and also a shorter piece the same width but about 6 in. long; this latter piece should have its corners slightly rounded. Place the two long strips face upwards on the table, end to end, just meeting, no more; then find the centre of the shorter piece and place it directly over where the two ends meet (see Fig. 12*a*).

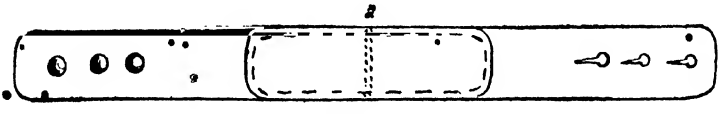


FIG. 12

Join the two pieces by smearing a very little adhesive on the under side of the short piece and pressing well down, and punch holes all round this middle piece through both thicknesses of leather, and thong, placing the knot on the wrong side in commencing and fastening off. This piece at the back not only forms an ornamentation, but makes the belt firm and stiff where it most needs it. To fasten the belt a clasp or buckle may be attached, but an original method will be shown.

Buttons and Button-holes.—From the shoemaker a kind of "press button" can be bought, in either black or tan colour. This button consists of two separate parts (see Fig. 13), and the method of fixing these is as follows: Punch a hole in the spot where a button is required; push the stem of *a* through this hole on to the right side of the leather; let the work lie flat on the table, so that this stem or shank stands upright; place the shank of *b*, which is hollow, over *a*, which it fits, and give *b* a sharp tap with the hammer, sending the tip of its shank down to the base of *a*, which is covered with the leather, and thus fixing the button so firmly that it should never give way. The top of the button can be covered with a disc of leather to match the colour of the article being made.

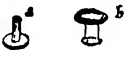


FIG. 13

Two or three of these buttons should be inserted on the left end of the belt, about 1 in. or 1½ in. apart, and button-holes made on the other end at corresponding intervals, so that the belt may be made narrower or wider to fit any sized waist.

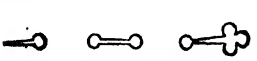


FIG. 14

Button-holes may be made in several ways. Fig. 14 shows three ways. The holes are punched and slits made with the scissors. Such buttons and button-holes form an effective ornament.

Book-cover.—The following description explains the making of a blotter, a note-book, pocket-book, or address-book cover. We will make a note-book cover to fit over the book. Cut the paper pattern in the following way: Fold the paper over so that the book lies closed and easily within, the back edge of the book lying along the fold. Press the paper well all round the book, thus getting the shape well defined on the paper; then take away the book and draw lines ¼ in. outside the impression on all

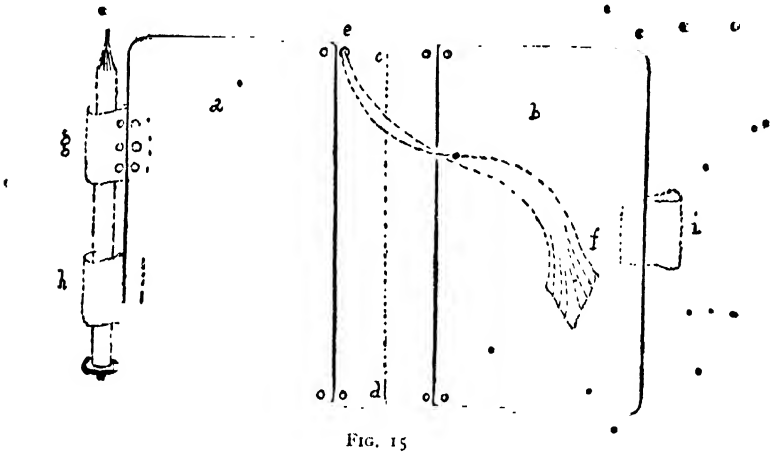


Fig. 15

four sides. If the corners are rounded, it is a decided improvement. Press the pattern on the leather and cut out, thus forming the outer covering. Two other pieces are needed to face this, each piece to correspond in shape and size to the outer covering, but within an inch of the back fold.

Next lay the outer covering face downwards, placing these two pieces one to the right, the other to the left, so that the edges of the under and over pieces meet nicely all round (see Fig. 15). The dotted line *c*—*d* shows the fold in the back edge of the outer covering, and *a* and *b* the two pieces to face the inside. To keep *a* and *b* in place while the holes are being punched, place a touch of adhesive in one or two places round the extreme edges. First

punch the holes indicated on the right and left of *c* and *d*. This does away with the danger of making a hole on the upright edges of the two inside pieces. Now turn over and proceed, on the right side, with the punching *all round* the edge of the cover.

Thong the pieces together as described in the making of the second bag. Suppose we commence with a knot at *e*, make the knot several inches from the end of the thong and begin on the right side, thus leaving the knot and tail on the outside of the cover. Proceed until the thonging is finished, and fasten off on the right side with a knot, or as described in the second bag where the fastening does not show.

The commencing end of the thong may now be pressed over on to the inside of the cover, and it forms a very convenient marker. Either attach a pretty bead to the end, so that it hangs just below the book, or fringe the end, which should widen out (see Fig. 15*f*). It will be seen that the inside pieces *a* and *b* form pockets, into which the covers of the note-book are bent back and inserted. Very dainty booklets can be made in this way. Later on a pocket-book might be made with loops at the edges, to hold a pencil (see Fig. 15, *g*, *h*, *i*), in the following way: Cut three pieces of leather; fold them over so that a pencil can lie within the fold; and, before thonging, insert two between the edges one side of the cover—the distance apart being their own length—and one between the edges on the opposite side, in such a way that when the book is closed the latter loop fits exactly between the other two, and that when a pencil is pushed through the three the book is kept closed. Holes are punched through these loops opposite to those round the edge of book, so that they are thonged in with the edge.

A much quicker way of making a book-cover is to cut out the shape in leather and mount it on the outer covering, using a good fixative to make it adhere well to the latter. The leather covering should be about ¼ in. larger than the book on all sides, so that the edges bend over in the form of what is known as "Yapp" edges. Probably Bibles were the first books to be bound this way. Of course, the great point in favour of the first method is that the covering can be refilled repeatedly, while in the latter

it is permanent. A very dainty address-book cover was made in a rust shade of brown by a little girl, and thonged with a soft reseda green.

A Blotter.—Make the covering as described, then take four or five sheets of blotting paper the required size; fold over to form a book; punch holes down the centre of fold, through which thread soft ribbon; then, folding back the first and last page, slip them into the leather cover.

A Man's Purse is another simple and easily made article. It can be cut out of three small pieces of leather, to make the back and front pieces and inner partition. It will always be understood that the shape must first be cut out in stiff paper—so it need not be mentioned again. The shape shown in Fig. 16 is a suitable one, and it can be made larger or smaller, though if the pattern given here be traced it makes a fair-sized purse. Let the children make their own patterns by paper folding and cutting as much as possible. The front piece *b* is the same shape as the back, so far as the curved line goes; also the piece between is the same up to the line *c*. The line *d*—*e* shows where the flap is folded over. The original purse was made of tan-coloured Velvet Persian, the back 6 in. long, front and inside pieces 4 in.; and the front piece curved at the top as indicated, the widest part being 3½ in.

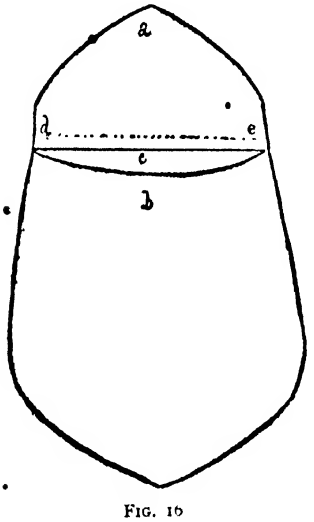


FIG. 16

After the holes have been punched, and before the thonging commences, the button-hole should be made at *a* and the button fixed (as previously described) at *b*. Then proceed to thong round the edges. Instead of the purse being fastened with button and button-hole, a band of leather could be fixed across the front and fastened in with the thonging (see Fig. 17) at *a* and *b*. This

strip should be ½ in. wide, and the flap should be made stiffer by facing it underneath with another piece of leather, which is attached with adhesive. When the flap is pushed through the band, the purse is securely closed. Plate I, H, K, show two forms of pence bags, which are very useful in saving the strain on one's purse caused by the bulging of copper coins.

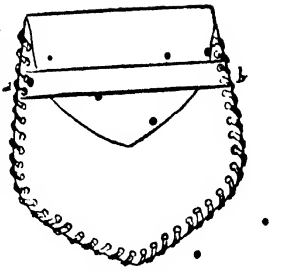


FIG. 17

A Necktie which looks well when worn by either lady or gentleman is very effective in leather. It can be made all in one piece, or in four separate pieces. If there is no lack of material,

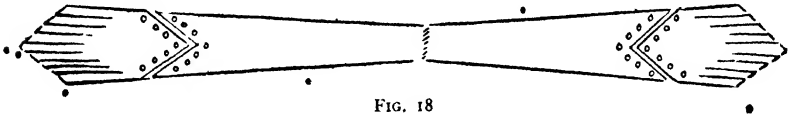


FIG. 18

the former way can be chosen, but in the latter method the ends of the tie may be cut from odd corners of the skin. The tie should measure 41 in. from tip to tip. If joined in the middle, let this be done neatly with oversewing in strong thread and then hammered flat. Fig. 18 shows how the pieces are joined. Fig. 19 shows actual size of tie end thonged. A tail end is left in commencing, which is fastened on the wrong side in the thonging, and in finishing off the thong is threaded through a rug needle and worked down through the last few stitches at the back; but it is so neat that the tie might be worn with the wrong side showing.

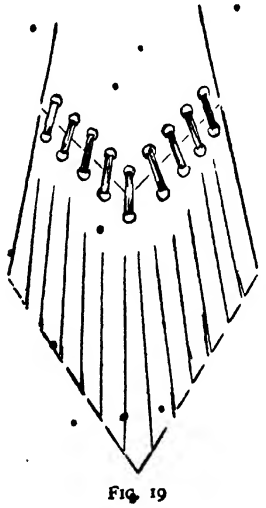


FIG. 19

A simple tie can be cut straight from the leather and left free of decoration. There is one point in favour of these leather ties besides their good appearance, and that is they are almost ever-

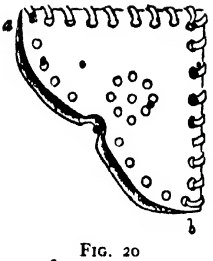


FIG. 20

lasting wear. A belt and necktie to correspond go well together.

A Simple Book-marker is one of the small items which can be made out of odd pieces of material. The marker can be any convenient size. Fig. 20 shows how it is made. A little punching forms a pleasing decoration, and if this is backed by a contrasting colour it is more effective. The pages of the book are slipped in (at their corners) to the opening *a—b*, and there is no danger of the marker falling off, as it fits like a cap.

Bows in great variety are obtained from quite small pieces. The shape is cut out and stitched in the centre to either a safety-pin or bow-pin, and over the stitching a strip of leather is wrapped

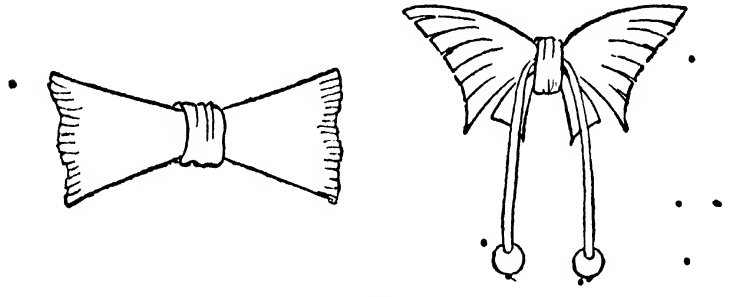


FIG. 21

tightly, which hides it and also draws the bow into shape (see Fig. 21). The strip which fastens round to the back may either be stitched in place or pressed down with fixative. If done in the latter way, it is quite firm, and is never likely to come undone of itself.

Brooches decorated with beads are very dainty, and give abundant scope for ingenuity. Fig. 22*a* shows one made out of a piece of leather only 1 in. square. Cut out a small piece of leather the same shape as the brooch, and stitch it firmly on to

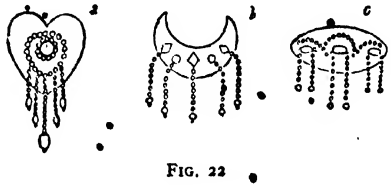


FIG. 22

a small bow-pin, thus forming the foundation of the brooch, to which the outside piece when decorated is firmly attached with adhesive. The heart-shaped brooch has a jewel sewn in the centre—these jewels are sold in a number of various shades at so much per thousand at most drapers' shops. A hole is pierced through the right and left sides, through which the needle and thread pass to fasten the jewel down to the material.

Proceed as follows: Bring the needle through from the back, and through one side of the jewel; thread a small bead on the needle and pass back again through the same hole; bring the needle through the back and through the other side of the jewel; thread a small bead and pass back again, so as to fasten down the jewel in the centre; bring the needle through to the right side, and thread as many tiny beads as will comfortably form a close ring round this centre; take the needle back through the leather, and bring it up on to the right again a short distance away; catch down the ring of beads here and there to the leather, and proceed to make the larger ring, or heart-shaped pattern of beads; then make the five pendant strings of beads with the oval-shaped ones at the end, and when completed fasten on to the foundation as directed. The crescent-shaped brooch has three diamond-shaped jewels with large round beads between.

A Peter Pan Collar looks well in leather (Plate I, B). Cut it out from an easily fitting shape and thong round either with the same colour or a contrasting shade. Two shades of brown, brown and green, or brown and blue, can be used. The collar can either be made with edge coming close to the neck or with a narrow band. If the latter method be employed, the band can be attached to the collar with adhesive, and two button-holes made, through which a stud or ribbon can be threaded. Instead of thonging the collar, another way would be to cut the border all round in a fringe, or instead of thonging with leather, thong with a long string of tiny beads, which makes a very effective border.

Safety Purse-bag.—The original (Plate II, A) was made in a soft shade of brown, 5 in. in length when closed and almost 4 in. wide. The method of working is nearly the same as for the gentleman's purse, except that a handle and draw-string are added; the former is attached to the back of the bag before the

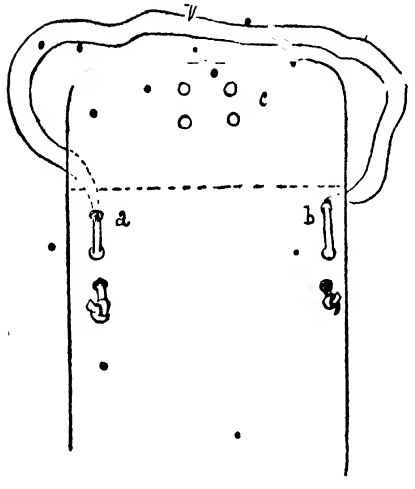


FIG. 23

two pieces are thonged together, and consists of a thong about 16 in. × ¼ in., slightly pointed at the ends, to allow them to pass freely through the holes. Fig. 23 shows, at *a* and *b*, how these pointed ends are passed through the three holes each side, to form the handle, and a knot made inside. Before the edges are thonged holes are punched in the centre of the flap at *c*, also on the front side of the bag at *d* and in a direct line with *c* (see Fig. 24).

After the front and back are thonged together, a strip of leather is cut about 24 in. × ¼ in., and this is threaded upwards from the lower holes *d* into the holes at *c*, across, and down again through the opposite holes. The ends hang below the bag, and are finished off with venetian beads or pretty wooden ones. This thong draws up when the bag is opened, and enables it to be securely closed when the ends are pulled downwards. The handle may be knotted in a loop, through which a belt could pass to allow the bag to be worn at the waist.

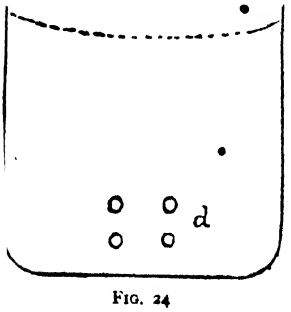


FIG. 24

Safety Wallet.—This is a little more advanced than the previous articles, but yet quite easily made. It consists of the following parts—back and flap all in one, front side, four or five thongs, and a metal ring large enough to slip on to the wrist. Fig. 25 shows the pattern of the back and flap. The front of the bag or wallet is the same shape as far as the curved dotted line; the length,

when closed, is 8 in.; the widest part is 8 in., narrowing to 5 in. at the top. Place the two pieces back and front, edge to edge, with the right side inside; oversew with thread of a corresponding shade the two edges *a*, *b* and *c*, *d*; gently turn on to the right side and press the oversewn edges inwards—the dotted lines *e*, *b* and *f*, *d* show the shape of the bag when the seamed edges are thus inverted, forming a kind of gusset each side. Now punch the holes round the lower edge of the bag—*b* to *d*—and thong. The thonging can be done with a double strip of leather, one crossing over the other in the manner of lacing one's boots; this makes a specially firm edge.

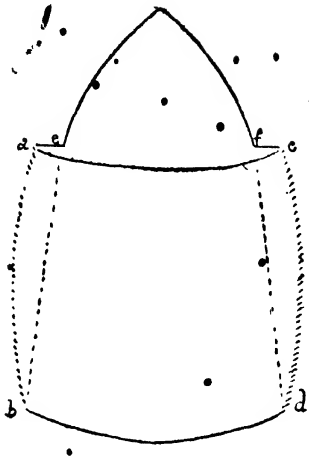


FIG. 25

The five thongs, 10 in. × ½ in., which are threaded through holes punched in the bend of the flap, are now placed in position at the top edge of the front piece, equal distances apart; let them lie straight out, but converging at the other end (see Fig. 26). Fix them in place with a little adhesive; cut a tab of leather the shape of the dotted piece; place it over the thongs as indicated; punch holes through each, right through

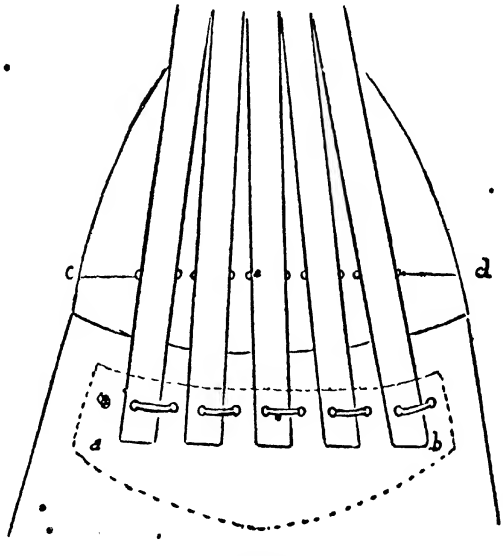


FIG. 26

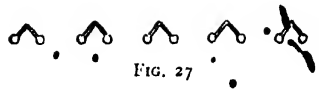


FIG. 27

the front of the bag and also through the tab; then lace securely in place. The five thongs and tab can be cut all in one piece, but the above way does not cut into so much leather. While the thongs are in position, mark the places where the holes are to be punched on the flap along the line *c—d*. When the punching is finished, cut from one hole to the other, to make the slits for the thongs to go through. If these are cut as indicated in Fig. 27, a good effect is obtained.

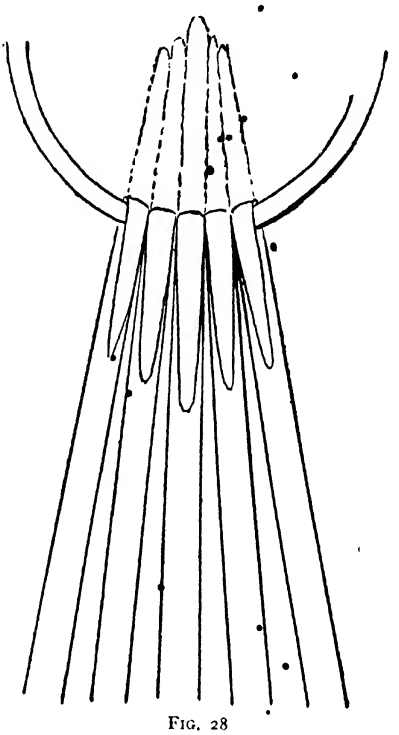


FIG. 28

Now the thongs are laced through their respective openings and drawn up firmly, through the flap which is pressed downwards, over the front of the bag. The end of each thong should now be slightly narrowed for about 3 in. Then place the bag perfectly straight on the table face downwards, with the thongs converging, and while in this position bring the ends of the thongs over the ring (see Fig. 28) on the thong again, pressing well down with adhesive. Or the thongs can be knotted down close to the ring (see Fig. 29); holes punched; a short thong of leather threaded through; and a knot made each side. This completes the bag except for the ornament on the flap,

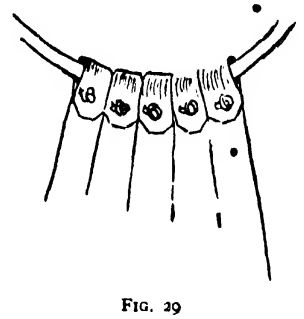


FIG. 29

which can be done as follows: Cut out of sheet copper a disc of 1 in. radius; place it face downwards on a piece of lead, or thick felt; and beat it down with a small round-headed hammer —a repoussé hammer is the best, but in the absence of that, hammer a round-headed nail on to the copper.

When the disc is turned face upwards, it will have a bumped-up appearance in the centre. Straighten the edges by tapping with the hammer, and pierce four pairs of holes round the edge. This can be done with a drill, bradawl, or a sharp-pointed nail hammered through. Polish up the copper and place it in position on the flap; press it well down to get the impression of the holes on the leather; and then punch the holes and thong the disc with a narrow thong of leather on to the flap (see Fig. 30). If the copper is left unpolished, the air oxidises it, and a lovely dull tone is the result. If preferred, the metal ring can be covered by winding a narrow strip of leather tightly round it before the five thongs are fixed in place.

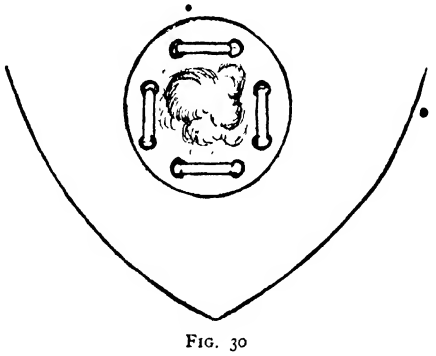


FIG. 30

Another Belt is shown in Plate I, G. It is formed of two bands of leather, the outer being a dull brown and the inner a soft bluish green. The outer band has a heart-shaped piece cut out at intervals, showing the green band. The bands are fastened together with adhesive and thonged all round. This makes a very strong belt.

A Muff and Stole made of leather are cosy, attractive, and easily made. For the stole two pieces of leather will be required for a large size, each piece 28 or 30 in. long, and shaped so that where the pieces join at the back the width is reduced by 3 in. The widened end measures about 8 in. Join by strong oversewing on the wrong side, and then hammer the join quite flat. Cut a lining of satin, or sateen, the same shape; make a narrow turning in both materials; and slip-stitch one to the other, taking care that the leather turning comes *over* the lining. It is quite un-

necessary to pad with wadding, as the leather alone is sufficiently warmth-giving. The ends of the stole are shaped and cut into a fringe 4 or 5 in. long (see Fig. 31).

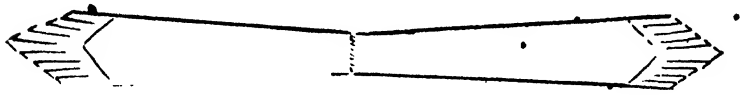


FIG. 31

The shape of the muff when opened out is shown in Fig. 32. The width at the narrowest point is 10 in. and the length 28 in. The lining is indicated by the dotted line, and should be cut ½ in. narrower than the leather, and escape the fringe at each end. Lay the leather face downwards and arrange the lining as shown, pressing it down here and there round the edge, with a little adhesive used very sparingly. Cut a long strip of leather just over ½ in. wide; place it over the edge of lining and level with the edge of the muff; and fasten it down with adhesive. Its position is shown by the inner line round the border. Punch holes along this double edge from *a* to *b* and from *c* to *d*, and thong over with a narrow strip.

A Small Inside Muff can be made by covering a sheet of wadding with the lining material, and forming it into shape. Stitch the top of it to the lining of the leather along the line *e*—*f*. When the outer covering is folded over, it can either be allowed to hang straight down, or the two edges can be laced together for a few stitches (*a* to *b* and *c* to *d*). A useful pocket can be laced on the back flap with the point coming over the top of the muff and fastening with a press-button, over which a metal ornament can be attached (Plate III, A).

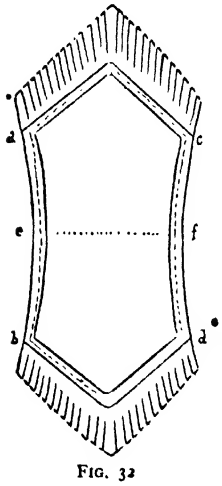


FIG. 32

A Muff Chain is very easily made by plaiting four thongs of leather together and finishing off with tassels. A very pretty effect is obtained by threading soft-toned wooden beads on these thongs, and pushing them up at intervals to lie on the outside

strands. Plate III, A, shows a muff and stole being worn, the former suspended by the leathern chain. The hat and feathers (Plate III, A) also are of leather; the colour is a soft shade of grey.

Other Objects.—The objects described in this article are only a few of the many and varied forms which boys and girls are capable of producing. They will quickly invent others. Let them but be conscious of a need and they will soon find a way of satisfying it. Although incised and appliquéd leather, punched and hammered work in calf-skin, cow-hide, and basil have all been described, yet in the making of the various objects we have confined ourselves to Velvet Persian, the reason being that the texture and colouring of this skin especially appeal to children. Of course, such things as the bags, book-covers, belts, purses, etc., can just as easily be made in basil, calf-skin, cow-hide, or morocco. Plate III, B, shows a capacious marketing bag made of imitation morocco. The method of working is the same.

Staining Leather. A few remarks on this subject may prove helpful. Velvet Persian needs no staining, since it is coloured when bought, but basil, calf, and cow-hide may be stained by applying spirit stains. Some aniline dyes are very good, while others are fugitive. It is well to bear in mind the following points. In staining first damp the leather thoroughly; use a camel-hair brush; dilute the stain well with methylated spirit, specially remembering that several applications of stain to get the required tone are better than one deep application of colour; apply the colour with a circular movement of the brush, and gently wipe off all superfluous colour with a soft cloth; do not apply a second wash of colour until the first be dry, or nearly so, in the case of a gradation of colour. In staining large surfaces a sponge may be used. It is well to try the strength of the colour on a waste piece of leather before applying it to the object.

Various Kinds of Leather.—The following are skins to be recommended for school handwork: *Velvet Persians*, from 3*s.* to 5*s.* per skin, may be had usually in the following colours—natural, grey, green in various tints, dark and mid blue, brown in several shades, red, maroon, purple, mauve, and black. *Basils*, from 4*s.* to 5*s.* 6*d.*, very large skins. *Ordinary Persians*, from 3*s.* to 4*s.* 6*d.* per skin, same colours as Velvet Persians.

Skivers, 2*s*. 6*d*. to 3*s*. 6*d*. per skin, same colours as Velvet Persians. These are thin skins, and are suitable for linings, etc. *Imitation morocco*, from 3*s*. 6*d*. to 4*s*. 6*d*. per skin in browns, greens, dull purple, and black. *Calf-skin and cow-hide* can be bought by the square foot.

Tools.—The only tool (besides ordinary school tools, as scissors, hammer, and ruler) necessary in making the articles described here is the punch or punch pliers (see Fig. 1), together with the little punch bits (*a*) which screw into the pliers. The cost of the latter is about 1*s*. 6*d*., and the punch bits, which may be had in various sizes, are 3*d*. each. A pointed tool called a tracing tool (see Fig. 2*a*), and made of steel, is used in tracing the pattern on to basil calf or cow-hide (see description of punched work), but a knitting needle enclosed in a handle of wood to give a better grip can be used equally well; so, too, can a bone crochet-hook. It is useless to multiply tools. Punches for decorating backgrounds on the stiffer forms of leather may be had in various patterns (see Fig. 3) from 6*d*. each. Nothing has been said about "modelled leather" or "carved leather," because both are rather too advanced for children of ordinary school age.

BOOKS FOR REFERENCE

ELLIN CARTER: *Artistic Leather Work* (E. F. Spon, London). C. G. LELAND: *Leather Work* (Whittaker & Co.); *Leather Work* (Dawbarn and Ward). THOMAS BULFINCH: *Leather Work* (Routledge).

LIII. HANDWORK AS A MEDIUM FOR ARTISTIC EXPRESSION

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Vital Connection of Workmanship and Art.—There is little need nowadays to insist upon the vital nature of the connection between art and workmanship. A workman can so enter into the nature of his material that the material reciprocally takes on the nature of the workman, and will respond to his subtlest desires and emotions. Velasquez and Whistler were great artists largely because they were workmen who felt in terms of paint—not colour in the abstract, but *paint*. So with the Gothic architects, they set out to conquer their material in the constructing of some required fabric, and the material responded by expressing their own innermost being. True, the conquest of the material is the result of attempts to construct an object which will fulfil some immediate purpose, but the power of artistic expression is largely a by-product of actual manipulation.

Handicraft as an Expression of the Self.—Handicraft may become the instrument of self-expression—that is, of art—in three different ways according as significance is found in (1) the use to which the work is to be put, (2) the actual fashioning of the material in the doing of the work, or (3) the adorning of the work with added ornament.

1. *An object may take on itself a symbolic meaning* and serve the same purpose in plastic expression as metaphor and simile do in literature. Some quality which a particular object may specially possess is transferred to another setting by means of the object itself. Thus a sword becomes a ceremonial expression for power, and a shield becomes a symbol of triumph. The most familiar example is perhaps the use of the cross in the Christian church.

The whole art of heraldry is rooted in this switching over of objects to represent actual deeds or qualities, thus bridging the barrier of languages for the knightly crusaders. School badges and commercial trade-marks are often of the same nature. A church is a house used as a symbol; a dinner given in honour of some distinguished guest is to some degree a symbol. Our life is full of traces of this expression by transference of meaning from one sphere of thought to another.

2. *Artistic expression may be found in the way in which an article is fashioned to fulfil its purpose,* that is, in the delicate adjustment of parts and balancing of masses so that the object awakens in the beholder, not merely a mental recognition that the object serves a certain need, but also a kind of imaged joy which the using of that particular article would give, and delight in the article as an expression of personal power over the material used. Some of the thirteenth-century Gothic cathedrals are marvels of daring in their economy of material.

A chair or a carpet or any ordinary thing may in the hands of a William Morris become in this way a work of art. Only by the exquisite character of the construction and the great economy of material consistent with the purpose of an object can we really express that intuitive mastery of the physical laws of the world which forms so large a part of the entity of man. Thus fine workmanship can itself be the means of artistic expression.

3. *Added ornament is the most obvious and usual method of giving expressive value to an article.* The true appreciation of the exquisite proportions of an object merely as filling a need is surprisingly rare among men, and a simple unadorned article rarely appeals as it should. Some kind of imposed decoration is usually desired. This surface work may sometimes, and should always where possible, emphasise the character of the article and enhance the beauty of its lines, in addition to any independent meaning the decoration may itself possess. As for instance, a well-designed fresco or wall-decoration will intensify the flat and solid character of a wall at the same time that it relieves the monotony of the large surface. This added ornament will be our chief concern here.

Applied Ornament.—The superadded decoration of an article

may be of three kinds, not necessarily separate one from another; in fact one piece of ornament often is of all three kinds (as, for instance, a vine design trailing round the rim of a chalice). The decoration may be (*a*) rhythmic, (*b*) realistic, (*c*) idealistic.

Rhythmic Expression.—There is a deeply rooted instinct in humanity to adorn that which it fashions for use. This instinct is evident very early in infancy, and in the most savage races as well as in the most highly civilised. The simple pot of African tribes is often most elaborately decorated with ornament which, in design if not in workmanship, will bear comparison with the civilised product of modern Europe.

In other words, mere decoration, apart from any intellectual significance it may possess, answers to some call from the depths of human nature—deeper far than the veneer of civilisation—in infant and adult, in savage and cultured, in the insane as well as the sane. We have but to take a simple unmeaning line or blotch and repeat it at regular intervals in order to produce a "pattern" that will, to some small degree, yield pleasure to the observer, of the same kind as the wild enthusiasm which the regular thump of a tum-tum arouses in the African native.

This response to repetition and symmetry, this delight in the decorative—the rapture of a dance movement or of the irrational recurrence of a rhyme, the joy of the child in the jingle of a nonsense-verse—this rhythmic appeal, which is shared with us by the lower animals, is doubtless expressive of the primitive forms of life from which we have evolved, and reminiscent of the simple reproduction of cell by cell in regular succession upon which all life ultimately depends. At all events, whatever be its origin, this rhythmic expression, if it be disciplined by educative influences (and not let run to seed as it is in some of the Asiatic nations), is always characteristic of healthy human life, and should play a part in any well-planned scheme of school work.

The products of a handwork course are obviously well suited to such rhythmic expression, and guidance as to the introduction of it is offered below. The appreciation of the decorative is especially dominant in childhood up to about eight years of age, although of course it persists strongly throughout life, and

investigation shows that it is somewhat more strongly marked in girls than boys.

Realistic Expression (*Perceptual*).—When approaching what Stanley Hall calls the age of stability, the child rapidly gathers interest in what is *real*: the pictures he admires are those which are most accurate in their presentation of physical fact; the things he makes must not in his eyes be make-believes, they must be *real*, for actual use; and he likes to draw real things with their real colours and all. Whatever he reads of he must needs make and possess and do. His need for expression now finds keenest satisfaction in the actual use of the senses in recognising the nature of the objective world about him.

At this stage if a child wishes to decorate an article, he will find joy in merely reproducing bits of the living world dotted over the object with little care about the rhythmic arrangement. In a form of illumination of manuscripts characteristic of the English schools of the Middle Ages, we find much the same arbitrary disposition in borders of accurate studies of butterflies, grubs, animals, brambles, and other natural objects that the monk happened to find in his immediate surroundings. The mediæval sculptor made the same patient studies in stone of leaves, cats, pigs, and of scenes of everyday life as the illuminator did in his manuscript.

This is just the character of work which appeals to the realistic sympathies of the boy or girl from eight or nine up to twelve or thirteen years of age. The realistic bent of girls at this age is not so pronounced as in boys, but girls retain a stronger feeling for the rhythmic and purely decorative.

Idealistic Expression (*Conceptual*).—When approaching the age of adolescence, when ideals are developed and the abstract rather than the real becomes dominant, the scholar is not content that his work should be merely a transcript from some natural object. There must be some further meaning implied. Objects take upon themselves symbolic meanings. A laurel spray must be fashioned into a wreath and crown a victor. National emblems gather significance. Every great character in history is made a hero, and each hero becomes to a large extent the symbol of some abstract ideal. Animals become part of the same language;

and the child will take a keen interest in the intricate art of heraldry.

The decorations of objects must now be symbolically fitting to the purpose of the object. Natural studies are now "adapted" to a more strict idea of design, and the rhythmic enters intimately into an alliance with the natural. The world as it is gives way to dreams of the world as it ought to be. Great care must be taken that a scholar's imaginings do not run riot and depart too far from the real, or degraded taste will result.

The Teacher's Share.—Having outlined generally what art tendencies the teacher should expect to arise in the child—but we must remember that *to some extent* all the forms of expression are used by children of all ages—what, we may ask, should the teacher do? No mere set of exercises or examples of the three forms of expression should be imposed upon the child. This would hinder rather than help the formation of individual taste. The need for decoration should be felt by the child and arise out of his own natural instincts—otherwise decoration should not be applied. But when some need is felt, the teacher can see to it that there are at the child's disposal copious suggestions for satisfying the need, especially in the way of good reproductions of examples of ornament and craftsmanship.

Without pressing the idea at all, the child may find an added point of interest if the examples shown are from architecture, manuscripts, or other work of the historic period he may be studying. It would at any rate be no loss to attach an historic association to any particular type of ornament. Not enough is made at present of the significance of ornament in the study of a period—of which examples will be found in any good history of ornament.

The examples shown to the child should not be merely reproduced by him; he should modify and adapt them to suit the character of the article to be decorated. The determination of the size of a pattern (when the kind of pattern has been chosen) should be a matter for individual judgment—as should also be the choice of colours. The teacher should not pass arbitrary sentence on the resulting piece of work, but by instituting neces-

sary comparisons in the mind of the child get him to pass judgment on his own work.

Application of the Recapitulation Theory.—The teacher's work as educator, as distinct from the somewhat easier rôle of teacher, demands a more or less prophetic insight into the probable nature of a child's future development, and a knowledge of the means by which that development can be made most valuable individually and socially. Although we can roughly outline the dominant interests of the average child during the broad divisions of his life, we must necessarily be in the dark to a large extent when we come to detail; but for guidance in choosing the nature of work which will satisfy his quickening impulses, we cannot do better than mark the lines along which a nation develops—cutting away, of course, such accidental experiments as came to nought and retaining the elements which produced the great periods when good taste was popular taste. We must not forget that our aim is not merely to *interest* the child; rather is it so to discipline his interests as to make possible the growth of independent judgment.

Let us follow briefly the course of artistic development in the Gothic architecture of England, and this should be fruitful in suggestion as to the method for artistic treatment of craftwork. Starting with Norman (English Romanesque), out of which Gothic arose, we find heavy masses of masonry relying for their strength upon the mere bulk of the walls and columns, constructed upon the simplest principles of building, representing very accurately the crude, simple, heavy character of the life of the people, with ornament very much in the nature of an afterthought, the carving being mere surface scratching mainly consisting of rhythmic line patterns—such as the familiar zig-zag ornament—or roughly incised outlines of childish representations of animals, and crude painting on the plain curve of the arches in lozenge- or square-shaped diapers.

The Development of Manipulative Skill.—However far this beginning may be from the ideal of school work which we like to present for inspection, if we would wish to be of ultimate service to the child we must let him start with this crude surface scratching on masses which as yet are unliving and unsympathetic

to his touch. Manipulative skill must be acquired in the actual carrying out of some needed piece of work. If we attempt by imposed exercises to produce technical skill before attempting what we may call real work, we shall actually not be successful in producing that skill, but, more serious still, we shall make the child timid in his experiments, and he will use his skill as something to be objectively applied instead of as a living means of expression. A child babbles his desires and joys many years before he learns grammar.

The Development of Artistry.—But out of this surface-scratching upon the unliving masses of Early Norman masonry, there developed the chaste beauty and waking loveliness of Early English architecture. Upon the evolution of the pointed arch from the problems of the vaulting, the stone became a living material. The dead heavy masses were whittled away into slender stems which gathered to themselves the daringly balanced thrusts of the arches, and instead of being hacked with rows of mechanical ornament, they threw out leafy capitals and twined living foliage among the shadows of the mouldings. So will our children, as they acquire experience of the nature of the material in fulfilling a certain purpose, reduce their work to exquisite proportions and the ornament will show their awakened interest in the real world.

The further development of Gothic in the Perpendicular period is full of warnings to the teacher. Here, with a more scientific and complete command over the shaping of stone, we find that the builders and sculptors were often lured by their desire to enrich their fabrics into an overcharging of a surface with mere superficial ornament. Shallow work executed solely to obtain an appearance of richness and costliness is usually the first step towards a period of bad art. When a child shows this tendency, let him be brought into more intimate contact with things *to be used* and not *to be looked at.*

The same course of growth can be seen in the history of illumination or almost any other art.

Guiding Rules in the Teaching of Artistic Handwork.—Let us now, in the light of the foregoing, try to derive a set of rules to guide our practice in teaching.

1. Whatever is done should have an origin in the child's own feelings and desires, and should not be merely imposed by the teacher.

2. Design in craftwork should develop in conjunction with actual work in the material used. Design can only precede execution in a very limited sense, because the character of the design is largely determined by the nature of the material, which can only be really known by experience.

3. Design should be rough and should not be required to be elaborately finished before the work is attempted, since the child would be wearied by it, and when he came to the execution his work would be hampered rather than helped by the details on paper, and his originality in working up the material would be checked.

4. Decoration should not obscure the utility of an object. The illumination of a capital letter, for instance, should not so complicate it as to make it difficult to read.

5. The lines of the decoration should, if possible, emphasise the character and purpose of an object. For instance, the vertical flutings of a Doric column give the suggestion of added power in resisting the downward pressure.

6. Plant ornament must not break botanical laws (*e.g.* branches must not grow out in backward directions).

7. Decoration should never interfere with the use of an object. For example, that portion of a chair against which one's back rests is the wrong place to put highly raised wood carving which will dig uncomfortably into the sitter's back.

8. Never allow decoration which has its origin in pretence and sham, for this is mere artistic lying (*e.g.* the staining and graining of wood to pretend it is some wood other than it really is). It is quite allowable to polish wood in order to bring up the grain and emphasise the character of the wood. Art should emphasise truth, not tell lies.

9. Considerations of use should always dominate considerations of decoration. Be sparing with the use of ornament. Concerning the application of ornament, the rule is: if in doubt, don't do it.

10. Let the work of the whole class at times contribute to

one unified piece of work if possible. This will impose naturally the necessary conditions for disciplining a child's individual expression, and will have value incidentally as social training.

Examples illustrating the Foregoing Principles.—Almost any piece of work will involve most of the above considerations; but to illustrate the trend of the whole article, we will consider the construction of a school or class shield for the purposes of recording victory in the playing-field or the class-room.

A shield is of such a nature that suitable work in its construction will be found for classes of almost any age by simplifying or complicating its design. It can be made of almost any material according as the capacity of the class permits. The general design can be a matter for joint deliberation with possible reference to the pictures of actual shields used in the historical period studied. The background can then be left in charge of one scholar, while the others are busy designing and making the applied ornament, a central piece of symbolism, surrounded maybe by a laurel wreath modelled or drawn from studies of real leaves; a number of children will be busy with the circles or small shields upon which the names of the victors are to be inscribed or painted, which may be of differing design, but must all adhere to one general size and shape agreed upon. Any of these applied elements may be left out if necessary. In early stages shields may be made in cardboard in such number that many of the children can use them to record successes. But the nature of a shield should forbid us violating its essential characteristics, as for instance by cutting pieces out of the middle of our symbolic shield which might let through the point of an imaginary sword, however fond we may be of pierced ornament. Pierced embattling round the tops of towers is just as false, and belongs to a decadent period when the symbolic use of embattling was forgotten, and it was used as mere ornament in all kinds of inappropriate places, such as round the bottoms of pulpits.

Examples of Good and Bad Decoration.—Instances of decorative work which are really good and should be used to illustrate lessons and to suggest ideas for a child's own adaptation are by no means rare, but the unfortunate thing is that instances of bad and meretricious decorative work are much more common

and are continually thrust before the child's eyes from glittering shop-windows.

All the craft work (weaving, printing, furniture making, etc.) of William Morris may be taken as good in every way; that is, the decoration does not hide the utility of the object which it adorns, the subject of the decoration is suitable to the use of the object, the decoration is designed to suit the materials in which it is carried out, and it does not pretend to be what it is not. The decoration of the initial letter (Fig. 1) is good, because it emphasises and does not confuse the letter itself; it also acknowledges the *flat* nature of a page of writing. Fig. 2 is a specimen of decoration which is superficially attractive, but is bad, because the ornament confuses the letter so that it is necessary to examine it carefully before one finds out what it really is (instead of being obvious at a glance, as a *useful* letter should be), and also it pretends to be of *solid* formation and disturbs the restful flatness of the page.

The fluting of a Greek column is good decoration because it emphasises the vertical nature of the support which the column affords. The turning of a table leg so that it looks like a weak pile of bobbins is easy, but poor ornament. The ornament on a plate should be round the raised edge, not in the centre so as to make whatever is on the plate look a confused mess; and it should be broad and simple, not need careful examination such as decency forbids at a dinner table. The pattern on a teapot or a jug should not stop short at the spout or the handle, as if those features were stuck on afterwards and were of the nature of accidents; the pattern should be carefully designed to go round the spout or the junction of the handle, so as to emphasise the fact that spout and handle are integral and necessary parts of the objects. If one examines a jug where the pattern is *interrupted* by the handle, the handle looks as if it were not safely put on—it looks liable to come off: it is therefore bad (Figs. 3 and 4).

Appliqué work is good and artistic if it is rightly placed and *does not pretend* to be anything other than what it is. Inlaying in wood is a type of appliqué work, and is right; but veneering is applied work which is *wrong*, for it is lying in wood—it pretends that an object is made of a richer material than it really is. When

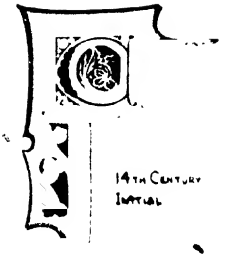

FIG. 1

FIG 2.

FIG 3.

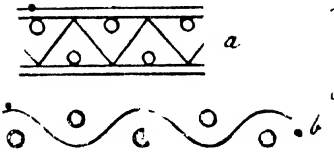

FIG 5.

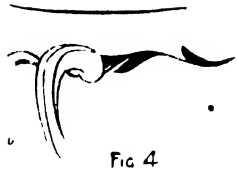

FIG 4

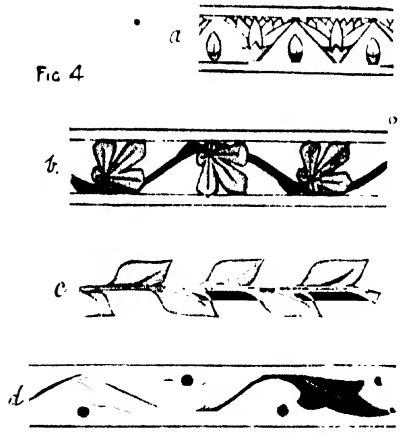

FIG 6.

CONVENTIONAL WREATH SUITABLE FOR STENCIL WORK

FIG 7.

FREER TREATMENT OF WREATH

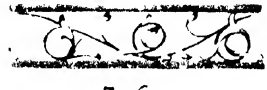

FIG 8

one material is *applied* to another for decorative purposes, whether it be in lace, cloth, braid, wood, or metal, the fact that it *is* applied work should not be hidden, and the manner of applying it, by stitches, metal studs, or otherwise, should not be hidden but should be so worked as to form in itself an added charm.

Suggestions for Children's Work.—(1) In Fig. 5 are given examples of simple rhythmic ornament which children can adapt (in size, colour, and detail) to the ornamentation of particular objects. Combinations of the examples given may be invented by children.

(2) Rhythmic ornament may have realistic elements added, but still retain severe forms as at Fig. 6. Children should make drawings from leaves and plants, and adapt them in the same manner. Again, choice of colours, size, etc., must be adapted to material. The limitations of stencil cutting form a good discipline in design, and emphasise the importance of *regularity* of repetition in decoration (Fig. 7). Stencil patterns may be done in chalk as a border to the blackboard, or on paper round the walls.

(3) Freer ornament may be attempted, still noticing a general rhythm, even though detail is not repeated, as at Fig. 8. Book covers may be ornamented thus, but designs should be kept *simple*.

(4) The various elements of a decoration might be given to the children, and they may be asked to combine them for a given purpose.

(5) Simple clay vessels may be made by children and decorated by simple line patterns cut with a point. Tin cans, cream-pots, paper plates, the school chalk-boxes, may be painted with a plain colour and decoration applied or cut. The object should afterwards be placed where it would naturally be in use, and opinions of the children should be asked as to whether the ornament is large enough, whether the detail is really effective, or wasted, whether the colours harmonise, whether it is rightly placed, and whether it will stand the use it will be subjected to.

Handwork and Drama.—One of the chief innovations in recent education, besides the great demand for active work in the form of handwork, is the insistence placed upon the need for active work in history and literature, the revitalising of what is conveyed

verbally—in other words, the dramatic method of teaching. Properly conducted, the value of the dramatic method in developing literary appreciation and in humanising past records is very great; in fact, in certain years of childhood it is the only method that can hope for success, since it answers so exactly to the awakening instincts. Early in childhood the drama may be the subconscious acting of the little one who so easily identifies himself with a story hero, in later years it may be the somewhat stiff and conscious attempt to think out the action suited to the utterance; but whichever it may be, it links up learning with life, and, what is of importance to us here, it provides a whole realm in which handwork is continually needed—handwork which consists not of a set of formal exercises, but which demands constant invention, constant judgment, and constant relating of work and material to the large whole of a living experience. If the dramatic method is to be real and not merely the dead husk of a good idea, handwork must be its handmaid; if handwork is to be vital, it must work continually on the assumption that the child is acting out a simplified existence of his own rooted in history, or literature, or science, on a gradually widening stage which involves problems of continual readjustment of scenery and properties in relation to his life.

Relation to Time-table and Syllabus.—Let us consider, then, how best to co-ordinate the school drama with handwork, and what effects it may have on our time-table and syllabus. We will first deal with the more definite dramatic work of producing a play by the top class, the boys and girls of which are fairly nimble mentally and physically, and are strong enough to deal with somewhat cumbersome material. We have been studying the "Merchant of Venice," let us say, and have decided that we will entertain our younger school-fellows and instruct our fond parents with a production of the Trial Scene. The casting of the parts and the practice in delivery we leave to the literature and recitation lessons. In the next drawing lesson we discuss the disposition and movements of the characters on the stage as the act progresses—we come to some conclusion as to the general arrangement of the court and the position of entrances and exits. We then share out the work of hunting up and making sketches of Venetian

interiors and costumes, which we do for homework in the public library. We come back to the next drawing lesson with our sketches, discuss the various suggestions, decide on our general scheme of colour so that our costumes will not clash, and then work up a complete colour sketch of what the interior must look like, and draw colour designs for costumes.

Then comes our handwork lesson: the chosen sketches are explained to the instructor (if a different person), and we make a small model to scale to see how best to fit up the scenery. We must then determine the dimensions of the wood to be strong enough for the framework of the pieces of scenery; we must design that framework and consider the method of constructing; we must measure up for the amount of calico to cover the frames; we must stretch it and tack it on and prime it with a mixture of whiting, colour, and size. Meanwhile in our drawing lessons we have been making careful studies of actual scenes needed for the work, so that when the pieces of scenery are constructed we can enlarge and adapt our studies. The same processes have been followed through by the girls (and boys if possible) with regard to the costumes: designs have been made, colour schemes decided, patterns fashioned, cheap materials bought, stencils cut for decorating the costumes (designs for stencil based on plant studies in drawing), dresses cut out and fitted, and suitably embroidered as befits the character according to our researches into Venetian costume. Some boys have made old Shylock's formidable knife and his scales, and after much interesting labour a dress rehearsal is imminent. A stage is not necessary, but it forms a very valuable piece of education to undertake the construction of one, since real building principles are involved.

The working out of such ideas in the class-room will make it impossible to draw out in detail a syllabus in the usual form, for the syllabus, like the work, will be a living thing and may grow differently from what at the beginning of a session we had anticipated. The time-table also must be more fluid than is usually the case in schools. There should be periods during the week which may be devoted either to literature, history, art, or craft, as the needs of the class demand. The artificial rigidity of time-periods which are made necessary by modern school conditions

should be relaxed as far as organisation will allow if the claims of education require it—there is no virtue in mechanical smoothness in the running of a school.

The Dramatic Impulse and Life.—The result, from a dramatic point of view, may or may not be good, but educationally the work can have the very highest value, for the working together socially for the attainment of one end, and that an artistic unity, is of great worth morally and æsthetically as well as mentally and physically.

The dramatic impulse with younger children works out much more intimately and subjectively in relation to handwork. With older children the handwork is incidental to a remote end, but with little ones the handwork is actually the end itself—life is the doing, not the having done. Working as little monks or mediæval craftsmen, they will write, illuminate, and bind their books; make pictured hangings for the walls of their classroom-monastery; their craft will be their very life, and they will celebrate in procession on state occasions their calling as craftsmen or soldiers (clad, of course, in armour and bearing weapons of their own design and make). Here will enter into the child's consciousness the root ideas of citizenship, the inter-relation of individuals and their various works—valuable far beyond any set of mathematically prescribed exercises in wood or cardboard.

It is not necessary here to show how intimate was the connection in the Middle Ages between the craft guilds and the production of the miracle plays, but we must realise that life-ideals such as the miracle plays celebrated must not be regarded as something apart from what we call handwork—our handwork must express those ideals, and mere formal sets of exercises cannot do this. Handwork, to be of greatest value, must have a *living* setting, that is, it must be dramatised.

Handwork in Relation to Music and Poetry.—The connection between the pursuit of a craft and the rhythm of utterance is one that is less tangible than in the case of drama, but it is none the less real. There are so many forms of handwork into which a definite rhythm enters that it becomes the natural thing for the human being to break out into song, and the work thereby takes on itself a romance and deep meaning for us that give a much wider cultural value to handwork. The boatman cannot help

singing to the cluck of his oars and the lap of the water ; the music of the rhythmic glide of a gondola is inextricably woven with romance—Browning, for instance, takes it as the atmospheric background to one of his finest short poems, " In a Gondola "—the craftwork of the sailors in a sailing-ship gains in value both mentally and physically by the lilt of the chanties, " songs that brace the arm, that help the winches round." The tailors were famous for their singing. In " Twelfth Night " Sir Toby's idea of supremacy in song is the singing of a " catch [round] that will draw three souls out of one weaver."

Nowadays so many discordant sounds break on our ears from the crowded street that our sense of rhythm is destroyed, and we are the losers thereby. Let our craft in the workroom, then, be alive with song, and let our teachers give us good, strong, healthy songs for the purpose. Our workroom should be noisy with the noise of harmonious industry, not with the noise of inharmonious idleness. The man who sings at his work is usually steadier than the man who does not.

The Psychological Relations of Music and Work.—There is also a close psychological association set up in our minds between the work we are doing and the song that may be running in our ears at the time. We remember many different pieces of work of which the very sight will set us off on some particular song, and if the song happens to be trivial and poor, our handwork is apt to be coloured by a kind of secondary quality derived from this association. Our attitude to things in life generally is affected very considerably by the accidental associations that were formed during early experiences of the things in question, so that it becomes our duty as educators to set up associations that are good to prevent accidental associations that are bad. Silence at work will not solve the problem, since although a boy may be silent at his work, in more cases than not a tune is running in his mind, though he inhibits the audible utterance of it. Healthy songs, songs with a strong rhythm, simple folk songs, or even simple rounds and part songs, are easily accessible nowadays, and if they are used for this purpose not only will the handwork benefit but music itself will take a more living place in the existence of the child.

Songs and poems about various forms of handwork are familiar

though not very numerous, and if they are used, not formally, but purely as an expression of the joy of work, they will help to unify the forms of expression and will raise the respect of the child for handwork, which is so essential a thing at the present time. We must knit up all the scraps of experience that break in upon the child from the strange world about him, and this can only be done by an active and freely expressive school life.

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LIV. HANDWORK AND MATHEMATICS

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The Basis of the Article.—Teachers in search of methods for their junior mathematical work will find in the history of mathematics an abundance of valuable material—in fact, they will find there the principles of which they are in quest, for the gradual development from things known to things unknown is to be found on almost every page.

Difficulties arose in every-day life even in the very early ages—the times of the Assyrians and Egyptians—which had to be overcome; and as a result of the efforts which these peoples made, the foundations of mathematical knowledge were laid. We see, in the results of the mathematical labours of these and of succeeding nations, the mental growth of the race; and since the mental growth of the child is so closely related to that of the race, a study of the latter will greatly influence one in framing schemes which have for their object the development of the mind of the child.

The period which we might call the *infancy* of the race naturally occurred before the ancients had discovered the secret and value of making permanent records, and of the nature of their progress we can but conjecture. The period of *childhood* is best illustrated by reference to work of the early Egyptians. The periods of *youth and manhood* in reference to the race are covered by the time which has elapsed from the beginnings of Hellenic civilisation down to the present day. In the Egyptians we find the school of *empirics*, whereas the Greeks were *philosophers*. Experiment was the basis of the accumulation of knowledge among the former; abstract reasoning characterised the work of the latter.

Obviously since handwork consists essentially of "particulars" it cannot be used as a "basis" in a course of abstract reasoning, though it lends itself admirably to the preparation of the mind of

the individual for such a course. Hence it is that handwork as a basis in a course of mathematics should be confined to the period of childhood, *i.e.* up to about the twelfth year.

The foundation on which rests the course which we are about to outline will be found in the history of Egyptian mathematics; three of the most salient facts there recorded are the following:

1. Land measuring became a necessity very early in the history of the Egyptians, owing to the continual inroads made upon the land by the repeated inundations of the Nile. Before rentals were paid for those lands on the banks of the Nile, measurements were made and compared with those of a previous epoch, and the rentals assessed accordingly.

2. On the Ahmes Papyrus there are tables, evidently the results of repeated experiments, which recall the "ready-reckoner" of to-day. One striking set of figures, when translated from the sexagesimal system of notation to our own, reads: $8^2 = 64$; $11^2 = 121$, etc.

3. The Egyptians had discovered the secret of setting-out right angles. A class of men known in those days as "rope-stretchers" possessed this secret, and they were in great demand during all large building operations. With an endless rope 12 units in length having knots at intervals of 3, 4, and 5 units respectively, they accomplished their work. Fig. 1 illustrates their method.

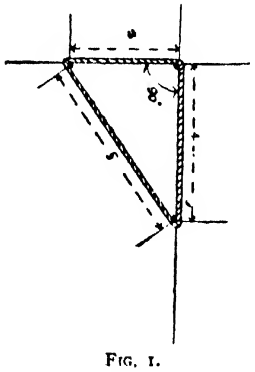


FIG. 1.

Around these three historical facts we can weave our course of mathematics (Junior) based on handwork. Our first conclusion from a study of the facts is that measuring and drawing were first done, and then the numbers contained in the Ahmes Papyrus were consulted before the rentals were estimated. Secondly, tabulated results were used before calculations were adopted. Thirdly, though they were aware of that property of a triangle, whose sides were as 3: 4: 5, which was of service to them, yet they never arrived at the general theorem of Pythagoras.

What a close resemblance we can see between the state of mind of the Egyptians and that of a child between nine and twelve years! We all remember the days when we were pleased because we could successfully go through that well-known puzzle: Think of a number double it, etc. This was exactly the state of mind of the Egyptians; they knew a secret, but had no idea of the proof of the theorem on which the secret was based.

Uses of Handwork in the Teaching of Junior Mathematics.—Nowadays one hears a great deal about correlation, and manual instructors having the desire to make their work as valuable as possible decide to correlate it with arithmetic. They imagine they have been successful if they ask a boy to find the volume of a marble-board which he has just made; and they may even get him to express the volume in letters instead of figures (thinking this is algebra), so deducing a formula (a thing strongly condemned, in the work with juniors, by the Mathematical Association).

What value has the work? Does it interest the boy? From experience I know it to be extremely boring to him; he wants to get along with his practical work, and considers time spent on working sums to be wasted. It may be all right from the teacher's point of view, but not from the boy's. Would it not be better for the teacher, knowing the value of correlation, to select some model which would involve a calculation before the boy could proceed with his practical work?

It should be clearly understood that there is no intention of outlining a full course in handwork for the period of childhood in this article, which will deal only with those parts which have a direct bearing on the teaching of junior mathematics.

Before a piece of work is undertaken let the teacher have a clear idea as to its object. First, is it going to furnish difficulties in order to lead up to and to show the necessity of learning some new mathematical truth? Secondly, has it for its object the illustration of some method which the teacher wishes the children to use? Thirdly, will it provide for the application of a rule recently learnt? Fourthly, does it merely furnish examples for calculation without any ulterior motive? If its use lies in any of the first three alternatives then its inclusion in the scheme is justifiable;

work coming under the heading of *fourthly* only has little to commend it from the point of view of correlation.

Choice of Materials.—This is a very important matter, and neglect in this respect leads to the introduction of some very ridiculous methods. One should keep in view that there is some relation between the mental powers and the physical capabilities of the average child ; and it would therefore be absurd to arrange to teach fractions by means of the ordinary manual training (woodwork), since children ought to have mastered fractions long before they are physically fit to undertake the use of ordinary woodworking tools. Again, thin paper, though perhaps suitable as a medium for teaching the mensuration of plane figures, does not lend itself to the teaching of the mensuration of solids.

Organisation of the Teaching.—The very best results are obtainable only when the work of both branches—handwork and mathematics—are in the hands of the same teacher. This obtains in Elementary but rarely in Secondary Schools. In cases where the handwork is in the hands of a specialist his scheme of work should be drawn up in consultation with the mathematical master, and each should be more or less acquainted with the details of the other's branch of work.

Scope of the Work.—It is not to be expected that each section of all the branches of elementary mathematics can be dealt with by handwork methods. Such methods have their limitations : for instance (1) questions involving the multiplication or division of sums of money are outside the scope of the work, but ordinary multiplication and division which are the basis of the compound processes lend themselves quite naturally to the application of such methods. (2) In algebra, regarded as the natural development of arithmetic, it is quite easy to solve very simple equations, arising out of problems, by cutting paper or thin cardboard, but it is undesirable to try to teach work on simultaneous equations or on indices by means of handwork. Quadratic equations can be well *illustrated* by cutting cardboard or paper, but at the stage of development at which children must have arrived before they can solve intelligently such equations a diagram is quite sufficient for the purpose ; and there is no need to have recourse to cardboard and scissors. (3) In geometry much valuable work of a *practical*

character can be done, and in a few instances articles can be made which will pave the way for a clear understanding of certain well-known proofs, but it is hardly possible to base a system of *theoretical* geometry on handwork.

The Ages of the Children for which the Work is Intended.—It is a great mistake to begin formal arithmetic too early; eight or nine years is quite early enough. With a class of twenty-four boys, beginning at the age of eight, I have experimented for about three years. In that time, with handwork as a basis, they have mastered almost all the arithmetic they will ever require; they have unconsciously assimilated a fair amount of algebra; and in addition they have grasped several fundamental geometrical facts.

Coloured-paper Work.—Each child should be supplied with a ruler, pencil, scissors, squared-paper book (divided into tenths of an inch), and some coloured gummed papers, and the teacher should have a squared blackboard. With the above it is quite easy for a teacher to begin a course in arithmetic with decimals.

Decimal Notation.—Children grasp the meaning of such expressions as 2·5 inches just as easily as they will learn that 2*s.* 4*d.* stands for two shillings and four pence. There is no need to enter into an elaborate explanation of our system of notation, since it is a pure convention and no useful purpose can be served at this stage by so doing. Let the children *use* the notation, and they will have gone far on the way towards mastering decimals.

The teacher should ask the children to draw, on squared paper, objects which they see around them; for instance, let him propose for one lesson to draw a garden gate similar to the one in Fig. 2, and to the dimensions there given. By so doing they get practice in measuring and drawing and quite unconsciously *grasp* the decimal notation by *using* it.

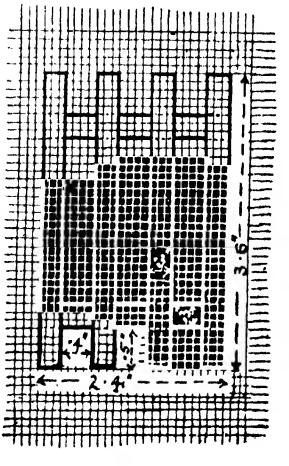


FIG. 2.

When the drawing is completed they should be asked to cut strips of

paper 0·3 in. broad for the cross rails and uprights—these strips must be cut exactly "parallel." The method of doing this can be easily got from the children, and thus they become acquainted not only with the *term* "parallel lines," but with the *method* of drawing them. The term "right angle" will probably be used by the teacher; since he will find some of the children measuring obliquely when marking, on the coloured paper, the width of the strips.

When the strips are cut they should be superposed on the drawing. This is by no means the easy task which we may be inclined to imagine; very great care has to be exercised in placing the strips exactly over the drawing.

From this and similar exercises the children will have an opportunity of grasping many mathematical facts, and in addition they will get a fair amount of hand and eye training. By a similar process the children can be led to see the necessity of knowing the "tables"—just as the Egyptians found the necessity of tabulating the squares.

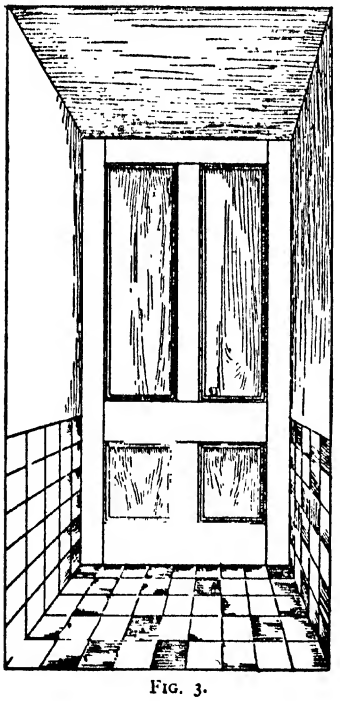


FIG. 3.

Areas.—Let us in this early work keep the interest of the children on something which to them is tangible. We all know how interested children are in drawing and making model houses; and this natural inclination can be led in a direction which will serve not only the purposes of handwork, but those of mathematics. Nearly all children have seen a vestibule or porch—let them have the pleasure of making a model of one.

We shall make the door with four panels (Fig. 3); and the walls will be partially, the floor completely tiled. All the measurements should be given in the

decimal notation for the reasons previously explained. The children should start by drawing the door in the middle of a page in their squared-paper book so as to leave room for the walls and floor.

It will be observed that not all the measurements are given;

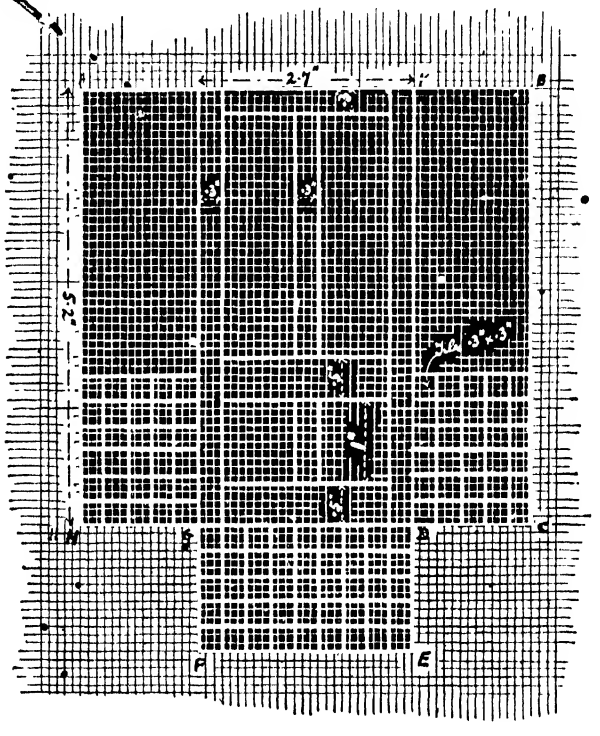


FIG. 4.

the remainder must be determined by the children. They should begin by drawing an oblong 5·2 in. long, and 2·7 in. broad for the door (Fig. 4); the outside upright pieces should next be drawn, 0·3 in. wide, measuring inwards; the top, bottom, and middle rails can now be marked, and we are left with only the two upright middle pieces to be put in.

The question arises, "What is the width of the panels?" The children should be led to see that when the width of the three uprights (that is, three times 3 tenths) is deducted from the whole

width (that is, from 27 tenths), the remainder (18 tenths) must be the width of the two panels together. Therefore each must be 0·9 in. wide, since two nines make 18. In this, trouble arises: the children experience the difficulty of not knowing the tables. Though the children may know neither that three threes make nine, nor that nine is the half of 18, the ingenious teacher will be able to lead the children to the (apparent) discovery of these things.

When the door has been drawn let the children superpose coloured papers over the drawing, making the panels a different colour from the framework. This procedure will show them the inaccuracies, if any, in their work.

Let us next turn our attention to the walls: we shall arrange to have six rows of tiles (0·3×0·3 in.) each row containing five tiles. To what height will the tiles rise on the walls?—six times 0·3 in. What will be the width of the walls?—five times 0·3 in.; and so on. How much of each wall is left uncovered? Here draw from the children that it is an oblong of such-and-such a height and width. How many tiles will be required for each wall? If they are made of two colours, how many of each will be required?

The work in connection with drawing and covering the floor is precisely similar to that for the walls and it is not necessary to repeat it here. All the calculations involved in this work must be done: some before the drawing can be completed, others before one can proceed with the covering. When the work is completed the paper should be cut along the lines AB, BC, CD, DE, etc.; and folded along the lines KD, GD, etc., so as to make the model of the porch. The teacher will have no difficulty in finding many other pieces of work, similar to the one illustrated, which will involve the necessity of knowing the tables.

Returning for a moment to the calculations involved in the making of the porch just described, we might extend the calculations in another direction; for instance, we had occasion to require the half of 18 tenths, and it is quite easy for children to see the relation between this and dividing 18 apples between two boys, or between it and finding the cost of each book if two be bought for 18*s*. Many other problems could be framed, but this is left for the individual teacher.

Multiplication Tables.—The tables should now be committed to memory, and this is very easily done if the children be supplied with strips of paper 12 in. × 2 in., 12 in. × 3 in., etc., which they should divide into square inches. They should pin these together, and use them until by constant reference to them they will be no longer required. There is no getting over the fact that a certain amount of drill work (which is very valuable from the *moral* or *disciplinary* point of view) must be done; but this is no longer irksome to the children—on the contrary they rather enjoy the work, since they know it will save them a lot of trouble counting squares, etc.

Following the lines of development of mathematical knowledge among the Egyptians, we should insist on the children *learning the tables and multiplication from areas, and not leave areas to be dealt with as an application of the process of multiplication.* This is essential if we are to proceed logically. There is little justification of the practice of teaching multiplication of integral numbers by one method and multiplication of fractions by another: let our methods be as far as possible of general application.

Squared-paper Work.—*Multiplication and Division.*—This work is not intended to be used for model making, but as a means of performing multiplications and divisions, which arise either out of the handwork or from problems. It can easily be made quite clear to the children that it is neither possible nor necessary to commit to memory the answers to all the examples which may arise. The necessity for having some means of performing calculations will therefore be apparent to them, but do not let these calculations be in the abstract. For instance, suppose we want to know how many 6 in. × 6 in. tiles will be required to cover a path 8 ft. long and 4 ft. wide: obviously, they cannot draw this full size; hence the necessity of drawing to some smaller scale.

Let us choose to represent each tile by a small square. How many tiles will there be in a row? How many rows? Having obtained this information from the children, let them draw an oblong 16 divisions long, and 8 divisions broad as in Fig. 5; and deduce that there

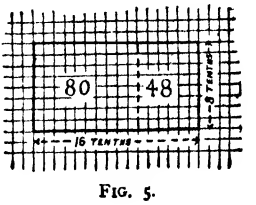


FIG. 5.

will be as many tiles on the path as there are small squares in the drawing—that is, 8 times 16.

Draw a line AB, thus dividing the oblong into two smaller ones, 8×10 and 8×6. In the former there are 80 small squares and in the latter 48, therefore altogether there are 128 small squares; thus 128 tiles would be required.

There is no need to put the 8 under the 16 and draw lines beneath, as is usually done. This only leads to the oft-repeated question, "Have we to subtract or multiply?" There is no need to use the terms "multiplication," "addition," etc.: in fact, I have had children who, even after they were able to perform multiplication and division of fractions and decimals, and square roots, were quite unfamiliar with these terms.

The teacher will be able to extend the method to multiplication by tens and units, and also to division. After a time the children ask the question "Please, sir, need we draw the oblongs if we can do the sum without?" and the obvious answer is, "No!"

Thin-cardboard Work.—*Areas.*—As soon as we leave squared-paper work, the difficulty of setting out right angles presents itself. Here let us adopt the principle adopted by the Egyptian rope-stretcher, viz. the property of a triangle whose sides are in the proportion 3 : 4 : 5; though instead of using string with knots, we shall introduce the use of compasses, and so pave the way for the work of practical geometry. At the same time the children should become acquainted with the more common fractions: halves, quarters, eighths, sixteenths, thirds, sixths, and twelfths. Rulers divided into sixteenths and twelfths are suitable for this purpose.

Working in Vulgar Fractions.—As an example let us choose to cut out a hurdle from thin cardboard to the measurements in the accompanying diagram (Fig. 6B). How much cardboard will be required?—evidently a piece $4\frac{7}{12}$ in. wide and $5\frac{3}{4}$ in. and $\frac{2}{3}$ in. long. How shall we add quarters to thirds? From the ruler they will see that $\frac{3}{4}$ in. $= \frac{9}{12}$ in.; therefore we have to add $\frac{8}{12}$ in. to $5\frac{9}{12}$ in.; the result is $6\frac{5}{12}$ in.; this is the length of the cardboard.

Each child should be given a piece of cardboard 7 in. long and 5 in. broad from which to cut the oblong $6\frac{5}{12}$ in. by $4\frac{7}{12}$; the procedure may be as follows:

Draw a beginning line AB, 6 $\frac{5}{12}$ in. long, near the edge of cardboard (Fig. 6A); measure AC 4 units in length (choosing as unit $\frac{1}{4}$ in., $\frac{1}{2}$ in., or 1 in., etc.); with compasses opened to 3

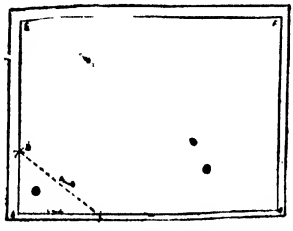


FIG. 6A.

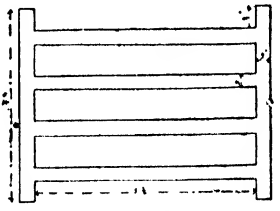


FIG. 6B.

units make an arc of a circle with A as centre and with 5 units as radius, centre C, make an arc cutting the former arc at D; draw the line AD and produce it. We have thus got one side and one edge of the oblong. Make AE, $4\frac{7}{12}$ in. long; and then complete the oblong by further use of the compasses, using E and B respectively as centres with which to draw arcs of $6\frac{5}{12}$ in. and $4\frac{7}{12}$ in. radii respectively, meeting at F. At this stage it will be found advisable to cut out the oblong, using a knife, straight edge, and cutting board.

The children should now proceed to set out the upright pieces of the hurdle, and then the top and bottom rails. The next difficulty which arises is, "What is the space between the rails?" This problem is of precisely the same nature as the one we encountered in finding the width of the panels for the door of the porch (see page 57). The children should be led to calculate the distance between the top and bottom rail ($2\frac{11}{12}$ in.). This has to be made up by three spaces and two rails; the two rails take up $\frac{8}{12}$ in., leaving $2\frac{3}{12}$ in. (*i.e.* $2\frac{1}{4}$ in.). We have now to find one-third of $2\frac{1}{4}$—that is, one-third of nine quarters ($\frac{3}{4}$ in.). Hence the space between the rails is $\frac{3}{4}$ in.

The children, being now in possession of all the measurements required for setting out the hurdle, should proceed to do this. Much skill will be acquired in cutting out the hurdle, and the children will learn to control their movements in order to avoid the danger points, which occur when cutting out the spaces between the rails.

When performing the calculation the teacher should not enter into the general methods of common denominators—in fact, he ought not to mention the names "numerator" and "denominator" to the children—such terms only tend to bewilder them. Quite unconcernedly he should simultaneously *say* and *write* on the blackboard $\frac{3}{4}$ or any other fraction which arises in the work; and the children will readily learn to express themselves in a similar way, and almost immediately write $\frac{3}{5}$ if they are asked to write three-fifths.

There are many more uses in connection with the teaching of junior mathematics to which thin cardboard (or paper) may be put. Children when studying tables in connection with square inches will get some idea of "bigness" as applied to pieces of paper, cardboard, etc. The further development of this idea leads up to multiplication of fractions. The children will know how to find the number of square inches in an oblong provided the lengths of its sides be given in integers.

Use of Geometrical Puzzles.—In order to introduce them to areas involving fractions, let us make one or two geometrical puzzles; for these arouse very great interest among boys nine or ten years old. By this time the children will have had a fair amount of experience in the use of compasses. Ask them to draw a triangle whose sides are 4 in., 5 in., and 6 in. long respectively. Let them cut it out in cardboard (or in paper first); and then let them try to make it into an oblong by cutting as they may think best. Usually not a single boy is successful, but all will have learnt much by the effort.

The teacher should then show them how to begin; he should show them how to divide a line into two equal parts, and get the children to apply it so as to find the mid-points of two of the sides; after joining these points and cutting along this line, the triangle is now divided into two parts as in sketch (Fig. 7A).

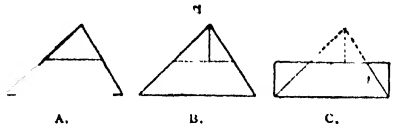


FIG. 7.

Suggest now that the small triangle should be cut into two parts so as to make the lower figure into an oblong. This time

some of the children will approach very near to the solution. It will be as well for the teacher to show them how to use a set-square and ruler in order to draw a perpendicular from the apex of the small triangle to its base. If they cut along this line (Fig. 7B), they will be able to fit the three pieces together so as to form an oblong (Fig. 7C). This greatly interests them; they take these pieces home and ask their parents to make either an oblong or a triangle from them. The teacher knows how valuable this is from his point of view.

After having done two or three of these puzzles, the question arises, "Which is the larger of two given triangles?" The children will suggest that the bigger triangle will make the bigger oblong, and since they know how to deal with oblongs, they are almost competent to settle the matter. Usually cases arise of oblongs whose sides involve fractions; so let us consider such a case. The following suggestion will indicate to the teacher a method which appeals very forcibly to children. They should not be told to reduce their mixed numbers to improper fractions, cancel, multiply, etc.; for this work has nothing to commend it in the case of children (and little in the case of adults), since they do not see the reason for the processes.

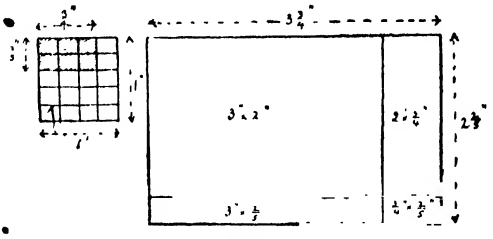


FIG. 8.

What is the quantity of paper in an oblong $\frac{3}{4}$ in. $\times$ $\frac{2}{5}$ in.? Such an oblong would occur in finding the area of an oblong $3\frac{3}{4} \times 2\frac{2}{5}$. Draw a square inch and divide the top line into quarters and the sides into fifths, and draw lines as in the diagram (Fig. 8); the shaded part is $\frac{3}{4}$ in. $\times$ $\frac{2}{5}$ in., and clearly it contains $\frac{6}{20}$ of a square inch.

The teacher will be able to extend this method to the problem of finding the area of an oblong $3\frac{3}{4} \times 2\frac{2}{5}$, since it can be divided into four oblongs, with each of which the children should be able to deal (Fig. 8).

By applying the above principles to the oblongs arising out of the geometrical puzzles, the children will be able to tell which is the bigger of two triangles.

Last year when I was doing this work with a class, one small boy, $8\frac{3}{4}$ years old, volunteered the remark: "Please, I have noticed during the last fortnight that every time we have done this kind of sum, the answer has been the same as the two top numbers multiplied together, and the two bottom numbers multiplied together; will it always be the case? because if so, we have no need to draw the oblongs every time." This boy had *discovered* the rule for multiplying fractions, and from that day he discarded the diagrams,

The following question and method of solution will indicate the lines on which the teacher can develop division of fractions. What will be the length of an oblong whose area is $2\frac{1}{2}$ sq. in. and breadth $\frac{1}{3}$ in.? Draw an oblong $2\frac{1}{2}$ in. $\times \frac{1}{3}$ in.; that is, $2\frac{1}{2}$ sq. in. Cut it into three strips, each $\frac{1}{3}$ in. wide, and place them end to end instead of side by side (Fig. 9). The children may fasten these three pieces together by means of gummed paper. The length is three times $2\frac{1}{2}$ in., *i.e.* $7\frac{1}{2}$ in. There is no need to give the children the rule "invert and multiply" if the work be done on these lines; but after a time the children always suggest the omission of the diagrams, which is an indication that they have discovered the rule for themselves.

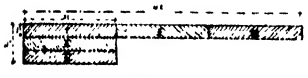


FIG. 9.

Another geometrical puzzle which greatly interests the boys, and which is of fundamental importance in geometry is, "How can we make one square from two squares?" Ask the children to draw two squares, say, 4 in. and 3 in. sides respectively; cut them out in cardboard.

Measure GH (3 in.) and join to A and to D. Ask the children to cut along these lines and to make a square from the pieces so obtained. They will be interested, on measuring the line AH, to find that it is 5 in. long. This should recall the method they have learnt of drawing right angles, and will carry their minds back to the stories which they have heard concerning the Egyptian rope-stretchers.

The children will ask if this can be done with any two squares. Let them try, and if they conclude that the method can always be applied they will have done a small piece of useful research, for they will have approached the generalisations of this theorem, which were propounded by Pythagoras.

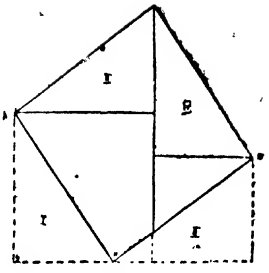


FIG. 10.

One more use of thin cardboard (or paper). From the nature of this example the teacher will be able to frame others, which, worked on similar lines, will lead up to it. On a tour a man spent £10 more on hotels than on travelling expenses; his travelling expenses were twice as much as he had left; at first he had £135; how much had he left? Let the children get into the habit of using an oblong to represent a sum of money and proceed as follows: cut out an oblong to represent the amount of money spent on hotels, and another one slightly less than this to represent the amount spent on travelling expenses; finally cut one half the size of the latter to represent the amount left (Fig. 11).

The children will see that the whole amount of £135 consists of £10, and five times as much as he had left. From this we deduce that five times the amount he had left = £125.

Therefore the amount left = £25.

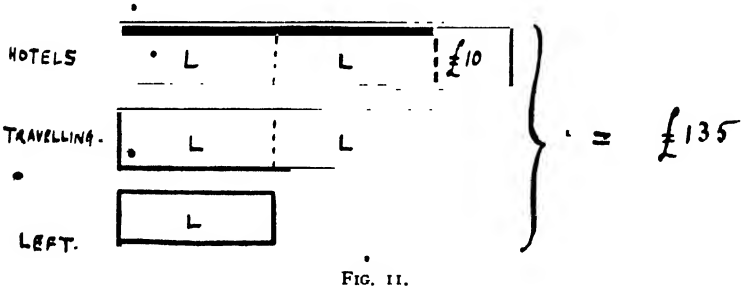


FIG. 11.

There is little difficulty in making the following transition:

(1) Five times amount left and £10 = £135.
Therefore five times amount left = £125.
Therefore amount left = £25.

and later:

(2) 5 L (L. = "amount left") and £10 = £135.
Therefore 5 L = £125.
Therefore L = £25.
That is, amount left = £25.

There is, thus, a gradual development from the cutting of the oblongs to the shorthand method used in algebra. This method can be worked with great success with children of the average age of ten years.

Thick-cardboard Work.—*English and French Measures.*—Children get very interested in making boxes out of thick cardboard, and we can easily utilise this interest in order to establish the relation between the English and French systems of weights and measures. Rulers can be got which are graduated in inches and centimetres, and the children should be required to notice that 1 decimetre equals 4 in. (approximately).

Let then each make a box measuring a cubic decimetre, and the teacher make one (without lid) 1 ft. long, 1 ft. broad, and 1 ft. deep. From these, three things can be established: (1) Similar solids vary in volume as the cubes on their corresponding measurements; (2) 27 cubic decimetres equal 1 cubic foot; and since 1 cubic ft. of water weighs 62½ lb., (3) 1 cubic decimetre of water (*i.e.* 1 litre of water) weighs 2⅕ lb. approximately. The name "kilogram" will afterwards be associated with 1 cubic decimetre of water, which weighs 2⅕ lb. approximately.

The Circumference and Area of a Circle.—The teacher could describe in greater or lesser detail the principle of the "cyclometer" used on a bicycle, etc., and he could then speak about a single wheel with a fork and show how it can be used for purposes of road measuring and for measuring the lengths of curves. The children may then make a model of this instrument

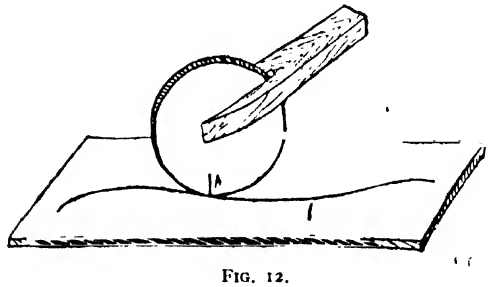


FIG. 12.

(Fig. 12), using a circular disc fitted into an ordinary clothes peg, or into a piece of $\frac{1}{2}$ in. × $\frac{1}{2}$ in. wood 3 in. long, in which they can cut a slot for the cardboard by means of a $\frac{1}{8}$ in. or $\frac{1}{16}$ in. chisel.

This being completed, let the teacher show them how to use it for the purpose of measuring curved lines—circumferences of circles in particular. By repeated applications, using different diameters of circles, they should be led to see that the circumference is rather more than three times the diameter; and then the teacher should give them the reasonably exact number $3\frac{1}{7}$. Using this, show them how to reduce a circle into a figure which approaches an oblong by cutting the circle up into twenty-four parts, and gluing the pieces (Fig. 13) to another piece of cardboard.

The piece ABC should be removed so as to occupy the position $A^1 B^1 C^1$. The distance from C to C^1 is roughly half the circumference, and from B to C the radius. Thus the circle is reduced practically to an oblong whose dimensions are half circumference, by the radius.

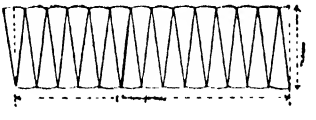


FIG. 13.

Volume.—Having determined the area of a circle, we can proceed to make a gallon and a pint measure. Since similar solids vary in volume as the cubes of their corresponding measurements, it is easy to see that the linear measurements of a gallon measure are twice those of a pint measure. Propose the problem: "Make a pint measure, having given that one gallon of water weighs 10 lb." Evidently there are $6\frac{1}{4}$ gallons in 1 cubic ft. Therefore 1 gallon contains $1{,}728 \div 6\frac{1}{4}$ cubic in. = 285 cubic in. approximately.

Let us choose 7 in. as the diameter of the base of the gallon measure; its area = $3\frac{1}{7} \times 3\frac{1}{2} \times 3\frac{1}{2} = 38\frac{1}{2}$ sq. in. Therefore the height of the gallon measure = $\frac{285}{38\frac{1}{2}}$ in. = $7\frac{1}{2}$ in. approx. Thus the measurements of a gallon measure are: radius of base $3\frac{1}{2}$ in.; height $7\frac{1}{2}$ in. (approximately). Therefore for a pint measure the dimensions are: radius of base $1\frac{3}{4}$ in.; height $3\frac{3}{4}$ in.

Let the children now proceed to make a pint measure out of fairly stout cardboard, paying attention to the binding round the

circular base. The length of the developed surface of the cylinder should be calculated by using the circumference of the circle, which may be determined by the rule already found and used.

Light Woodwork.—At this stage the children ought to have seen the value of learning methods; and in addition they ought to have learnt them. Let us now see that they have opportunities for applying this knowledge. Small frames should be made which involve more complicated spacing of bars and uprights—the initial difficulties in the process of which we encountered in making the porch and the hurdle (see pages 55 and 56).

The teacher has only to look around him, and to get the children to do the same, in order to find suggestions for articles to be made in wood; bedsteads, chairs, small chests of drawers, umbrella stands, etc., lend themselves very readily to the treatment we require.

General Summary.—It would be well for the teacher repeatedly to refer to the principle underlying the questions, first, secondly, etc. (see page 53), and to see that his work is framed accordingly. Let him try this *historical treatment* in his methods in junior mathematics, and he will be very agreeably surprised at the results.

Of course within the limits of an article of this description it is impossible to go into very great detail; however, there are advantages arising out of brevity when it is designed for the purpose of cultivating initiative. Broad outlines are indicated; let the teacher frame his own detailed scheme, and then he will work it better than he would a scheme outlined by another.

In conclusion let me say to the teacher of handwork, "Spare a few moments for the reading of mathematical history," and to the teacher of junior mathematics, "Acquaint yourself with the principles of handwork." Both will find in these things much to interest them, and I am sure the pupils, as well as the teachers, will profit by these inquiries.

BOOKS FOR REFERENCE

F. CAJORI: *A History of Mathematics* (Macmillan). W. W. R. BALL: *A Short Account of the History of Mathematics* (Macmillan).

LV. SYSTEMATIC METALWORK

By J. Scott Knight

Teacher of Handicraft at the Hornsey County School; formerly Editor of "Manual Training"

In this section it is assumed that pupils have already had some experience of the commoner metalworking processes. The procedure now suggested is to indicate sets of problems, each set surrounding some group of processes, and to allow individual taste and bent every reasonable freedom. If a pupil decides to continue on one line of work and thus secures considerable skill and power along that line, he at the same time comes in contact with others engaged in widely differing work with a resultant gain in breadth. If he chooses to vary his work, and most do, no objection is raised, even when the intention is obviously to select the "jam" models and reject the "powder" ones.

Procedure.—The lathe and forge accommodation is usually limited, and some little control is necessary to secure fair opportunity for all, either by asking for a definite amount of other work first, or by allotting a proportion of the available time at lathe and forge to each. Boys should generally work in pairs, and always so in the case of lathe and forge.

Drawing either precedes or follows the work, as may be best for the particular problems. Sometimes a sketch is sufficient, sometimes the work is executed to a written statement of conditions to be filled. For example, if a wrought iron handle is to be made with a ring end, neither concept nor construction is helped by a geometrical drawing to scale, showing a geometrically perfect handle.

Each new process is discussed by the whole class, and the salient points noted down.

Records.—With such a variety of work the need for individual records becomes imperative. A plan which works well is to have

a page of the drawing book ruled off to give columns for date, *work in hand*, *actual work done*, lesson given, marks. An entry is made under each head for each lesson. On the completion of a piece of work the pupil writes a brief criticism, mentioning particularly how far the object fills its intended purpose, and the time taken. This criticism, when accepted and initialled, is the pupil's authority for starting new work. It is interesting to note that after working this idea (due in the first place to Mr. Gustav Larrsen) for several years not one occasion has arisen where it has been necessary to modify a criticism as being too flattering.

The initial trouble of starting such a system is considerable, but once it has become a school habit, the teacher's portion in it is small, being confined to reading the criticisms and glancing over the record. Lapses on the part of the boys are few and far between if the rule "No record—no marks and no models" is strictly applied.

Factory Visits.—These should form a definite part of any broad metalwork scheme. It is not only possible but highly probable that the limitations of the school handwork room may be accepted as normal and permanent factors by pupils whose experiences extend no farther, and that a narrow and cramped outlook may thus be engendered. The day of laborious hand processes is past; and while their educative value stands permanent for all time, it is neither lessened nor belittled if factory methods are shown in their proper light.

This involves something more than a processional march round any convenient factory. Some preparatory teaching should be done, and attention should be focussed on those factors which, if less obvious than the actual processes, are at least as important.

The reasons leading to the placing of the factory, the supply of raw material, of labour, of power; the methods of securing punctuality, of maintaining standards in size and finish; time, piece, and composite methods of payment, and the grading of work as unskilled, skilled, and professional, with the resultant social and pecuniary differences; ways of costing, of issuing stores, of checking waste,—all should receive attention.

Leave to visit factories is readily given to the teacher who knows just what he wants, and puts his case clearly and definitely.

It is necessary for a prefatory visit by the teacher to precede the school visit, and it is wise to inquire whether the manager or whoever cicerones the party prefers to leave explanations to the teacher. Once entry has been secured, the visit should become an annual affair with obvious economy in time and teaching effort.

Sheet Metal Problems.—This heading embraces a very wide range of work. The examples described are chosen as being easily possible, of safe appeal and capable of individual variation. The procedure in presentment is to elicit the essentials of the object to be made; to define the limits of size, to discuss methods of construction, to decide upon means of ornamentation, and if necessary to show solutions of the problem.

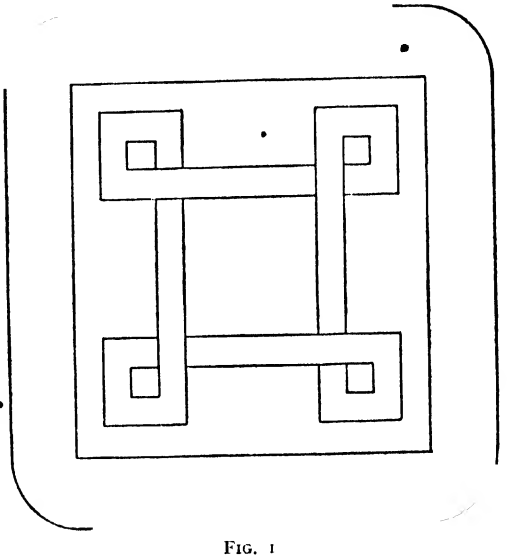


FIG. 1

Ashtray (Fig. 1).—In copper, brass or zinc, 22 G. The object of this is to furnish a simple application of ornamentation by outlining a design with traced lines and breaking up and depressing the ground, so as to leave the design in slight relief. As all the processes are new, it is perhaps well to suggest some such design as that which is shown, which is technically easy and yet effective. After the metal is cut, a small margin of waste being allowed, it is flattened and cleaned, and the design drawn in pencil and lined in with a scriber. The metal is either fixed down upon soft wood by driving nails around it, and then bending them down so as to form clips, or else is laid in a mixture of pitch, plaster of paris, resin and tallow. This mixture is melted in a saucepan and

poured into a wood tray, and the metal is embedded in the plastic pitch.

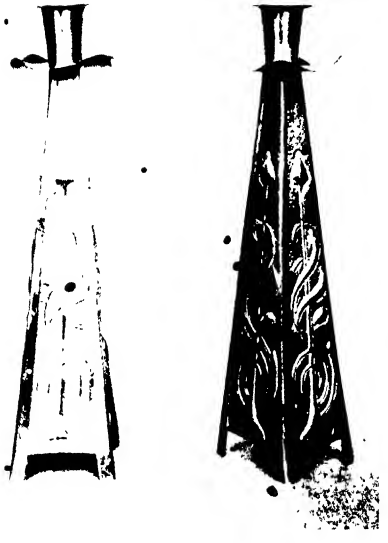
The lines are now "traced," that is, forced down into a narrow groove. It should be noted that the tracer has not got a cutting edge, but that both the points and the edge have been slightly rounded. All the short lines should be tackled first. Beginners lean the tool away from the direction of progress, or hold it vertical and advance it by steps. The correct way is to hold it almost vertical, and to aim at continuous movement and of course a continuous line (Plate V).

The ground is forced down with a round-ended punch. If a large one is used the marks are placed, if a small one the punch is held just above the metal, and blows are rained upon it while the left hand moves it about, until no plain places are left. When the matting is completed, and the work is removed from the block or pitch, it is usually necessary to straighten it. To avoid flattening the design the metal is placed face down on a sandbag and tapped with a mallet. The edges and corners are then cut with snips, finished by filing (N.B.—*not* in the vice) and rounded with emery cloth. The edges are turned up on the edge of a block of wood, bending each in turn about 10°, avoiding striking the corners. These are finally shaped on the beak of the anvil. The method of cleaning is to use pumice powder and a stiff nail brush. It is obvious that a hexagonal or octagonal tray can be substituted, and that by choosing an octagonal shape, cutting away alternate sides and bending the remaining ones down to form feet, an effective teapot stand is made.

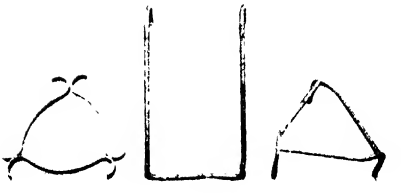
Candlesticks (Plate V).—In brass or copper, 22 G. Two type are suggested. In both the method of ornamentation is that just described. In the low type the deckle edge is formed with round-nosed pliers. The circumference of the disc is divided up by radial lines, and the metal gripped at these intervals and bent up, a little at a time, with the pliers. The first bends must be very small, otherwise distortion will follow. The candle holder is a piece of $\frac{7}{8}$ in. tube with a disc soldered on. The metal for the handle is cut nearly double width, and each edge folded to make it stronger and more comfortable to hold. It is riveted in place.

In the tall type two of the sides are provided with flanges, and

TRACING



CANDLESTICKS

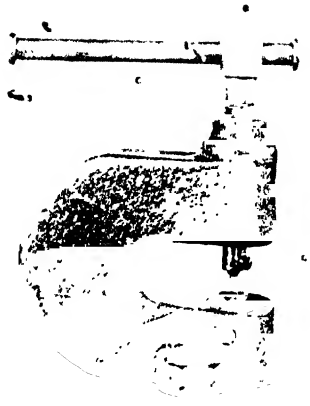


IRON STANDS

LIGHT DRILLING MACHINE

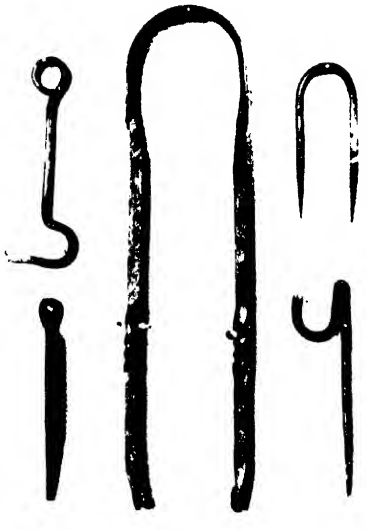
CANDLESTICK

PLATE VI



PUNCHING BEAR

TURNING SHORT TAPER

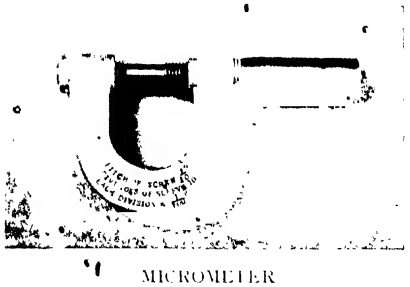


GATE HOOK WALL STAPLE

COAL TONGS

DRIVING BRACKET ROD REST

SURFACE GAUGE



MICROMETER

the four pieces are soldered together. This is an awkward job. Probably the best method is to bend the flanged sides to a sharper curve than required, and the plain sides to an easier curve. All meeting surfaces are tinned and fluxed, and the four bound with wire, and a blowpipe flame used till the solder just runs. The candlesticks illustrated have a flange on one edge of each side. This is *not* the best method. The top is filed flat, and the grease catcher and candle holder soldered in place. An alternative candle holder is made from a helix of wire.

Watch Stand (Fig. 2).—Copper 22 G. Tracing, matting, raising, and bending are combined in this. The hollow is beaten down (technically, "raised") either on a sandbag or on a suitable hole in the doming stake. If the sandbag is used, a hole is bored of the required diameter in a piece of hardwood, and the border round the raised part can then be flattened. The work is then fixed in pitch and the other processes carried through, cutting to outline and bending the wings being left to the last.

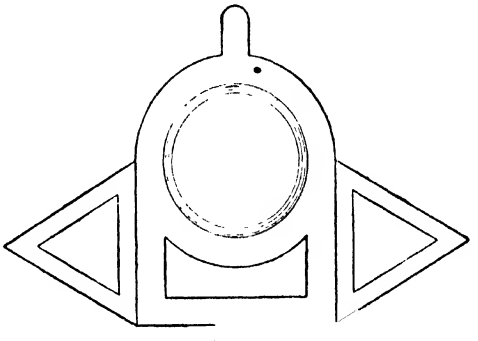


FIG. 2

Bowls.—Copper 22 G. In the absence of special stakes, bowls can be made on an improvised lead stake. Into a ladle full of lead, just on the point of setting, are dipped the heads of several nails driven into a piece of wood, thus attaching a hemisphere of lead to the wood. The wood is held in the vice and the disc which is to form the bowl is partly stretched in the centre by beating into a hollow in the lead with a round-paned hammer, and partly contracted round the outside over the convex surface of the lead, working in each case in concentric rings and annealing often. Bowls thus made form flower bowls, more or less ornate, when equipped with sheet metal supports, riveted or hard soldered in place. Or they may stand above a sheet metal base, on tubular

legs, with or without turned feet and caps. Again, a bowl, conical rather than spherical, may when inverted form the basis of an inkstand.

Spoons (Fig. 3).—In copper or brass, 18 G. A spoon is of course a tiny bowl with a handle. Caddy spoons are simple, as the bowl, being hemispherical, can be formed in the doming stake. The edge of the bowl is trimmed with a file after raising, and the handle, which may be filed to outline and ornamented by piercing or twisting, is filed to fit its curve exactly. The surfaces which are to be joined are scraped clean, luted with a cream made by rubbing a crystal of borax in a little water on a rough earthenware plate, and then both are nailed down on a charcoal block. One or two small pieces of silver solder (which comes in the form of thin sheet) are coated with borax and laid in position.

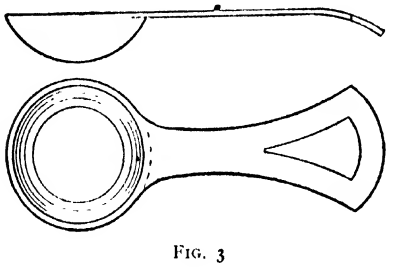


FIG. 3

The metal is then heated up with a large soft blowpipe flame, and when all is fairly hot a small intense flame is directed on the joint until the solder is seen to run. It is necessary to heat gently at first or the rapid conversion into steam of the water in the flux will blow the solder off. Silver soldering is only a matter of cleanliness and close joints. It is even more decided than soft soldering in refusing to condone ill-fitting work. The heating leaves the metal soft and, after filing up the joint, the handle should be carefully hammered to stiffen it. For this reason if the stem is to be twisted this process is left to the last.

The above are just sketchy suggestions as to possible forms which sheet metal problems may take. Trays, salvers, tobacco jars, cigarette and stamp boxes, table ware are all within the resources of the handwork room. When it is realised that 80 per cent. of silversmith's work and 60 per cent. of domestic metal articles are made from sheet metal, there need be no brain-cudgelling to find suitable problems.

Vice Work.—Here again the range of possible work is very wide

indeed. The problems described are chosen as being typical of ordinary everyday work.

Iron Stands (Plate V).—Steel $\frac{1}{2}$ in. × $\frac{1}{8}$ in. or $\frac{1}{4}$ in. round. The processes here are bending and either riveting or notching. Steel of this size can easily be bent cold, unless the curve is one of small radius, when the blowpipe flame may be requisitioned. Boys should be reminded that riveting requires room for striking the rivet, and that a pleasing design may be unworkable. If the joints are notched, they should also be brazed. This process is akin to silver soldering, but the alloy (a brass) used contains no silver, and thus has a higher melting point. Borax can be used as the flux, but the blue borax compound used by cycle makers is more convenient.

The joints are cleaned, coated with flux, placed in position on a firebrick, surrounded by asbestos cubes and heated. When the heat reaches bright red, a little spelter (which comes either in granular form or as coarse wire) is placed on the joint, and the heating continued with a more intense flame until the brass is seen to melt and run. If there is any doubt as to whether the brass has run, one may be sure it has *not*, for the actual flow is unmistakable.

Railway or Van Key (Fig. 4).—Iron gaspipe $\frac{1}{4}$ in. bore, and $\frac{3}{8}$ in. round iron. The outside of the tube is filed smooth and round. One end of the stem is filed hollow with a round file to fit the handle portion. It is better to file away enough to leave two strips to nearly surround the handle. They are not needed for strength, but for holding the parts together while brazing. The other end is cut to length and filed square. One end of the iron is filed down for about $\frac{3}{8}$ in. to fit inside the tube. In brazing this joint is made first, as it is less liable to be disturbed than the other. The parts are fluxed as usual, and a little piece of spelter is placed

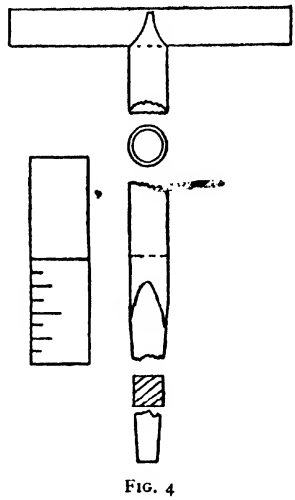


FIG. 4

inside the tube, and heating is continued till the brass shows outside, the solid end being placed down. The handle end is then cleaned and fluxed, a piece of spelter slipped inside the stem, and the handle put in place and fixed with the encircling strips. In making this second brazed joint, care must be taken not to heat the first more than is necessary. After the metal has cooled the solid end is filed square in section and tapering, the surplus brass filed neatly away from the joints and all surfaces filed bright and finished with a strap of emery cloth.

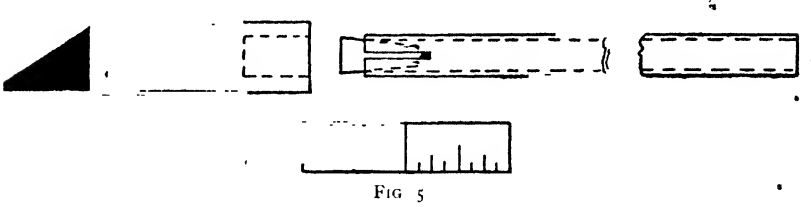


FIG 5

Soldering Iron (Fig. 5).—Copper rod $\frac{5}{8}$ in. square and iron gas pipe $\frac{1}{4}$ in. bore. The work on this is straightforward. The shape of the point is an economical one, for an oblique saw cut partly forms two points. The tube may be screwed into the copper, but copper is tenacious and liable to break the tap, so plain drilling

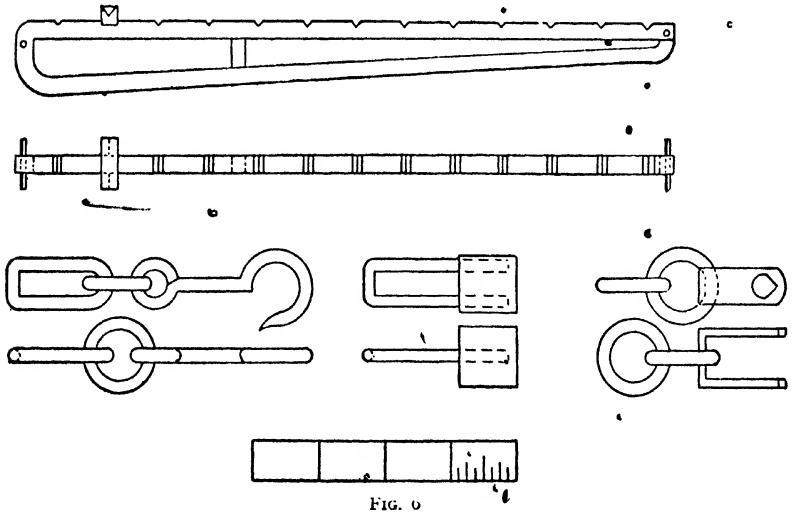


FIG. 6

and either cross-pinning or wedging will be found better. In the latter case two saw cuts are made along the tube, and at right angles to one another, and a piece of round iron is filed to a cone of small taper. This cone is placed inside the sawn end, and when the tube is driven into the hole, its end is expanded and so fixed. The tube is cross drilled to keep it cooler.

Steelyard (Fig. 6).—Mild steel $\frac{1}{4}$ in. square. The construction can be seen from the drawing. The knife edges and the strut are notched and brazed in place. Lead is used for the weights, a wood mould being made for casting the lead round the steel staples. The alternative form is the Danish steelyard, in which the fulcrum is moved and not the weight.

Other Vice Problems.—Once the freedom with which flat bar steel can be bent, twisted, drilled, riveted, and brazed is understood, boys soon find problems for themselves. To give some extremes, cycle carriers, model lattice bridges, iron fittings for a scout's cart, nutcrackers, retort stands and clamps have been and can be made.

Forge Work.—Smith's work in its simpler forms consists of bending, alteration of section of short portions of a bar, drawing out and thickening by "jumping," *i.e.* shortening a bar to increase its thickness. Examples should be chosen to establish these processes.

Wall Staple (Plate VI).—Iron $\frac{1}{4}$ in. round. This introduces drawing out and bending, and being simple enables attention to be given to general principles of fire management and the mechanics of hammering. Boys should be brought to see that the reaction of the anvil has an effect very nearly equal to the blow of the hammer, and taught in producing square and oblong sections to keep the knuckles of the left hand against the side of the thigh, and to rotate the bar through 90° between the blows or pairs of blows. The first point should be made on the end of a bar, bringing in the tongs for the second end. The necessity for scrupulous care in choosing suitable tongs (those which grip at the end and not near the joint) should be insisted on, even if the expedient of making every boy show tongs and work before commencing has to be made law. Accidents of the most serious kind have followed the use of unsuitable tongs. The bending is simple.

Driving Bracket (Plate VI).—Steel $\frac{3}{4}$ in. × $\frac{1}{4}$ in. This is a

ase of drawing out where one dimension is unaltered. In forming the head the part of the anvil with its edge slightly rounded should be chosen. The hole is made by drilling.

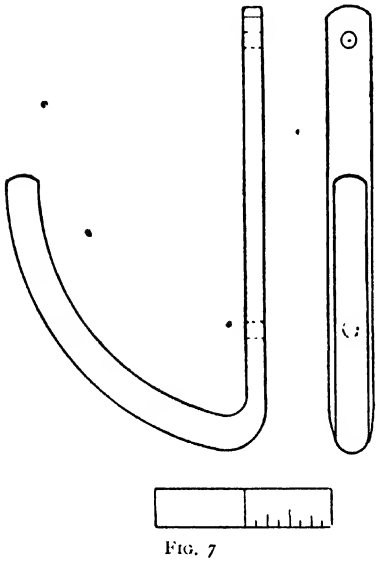


FIG. 7

Bath Hook (Fig. 7).—Iron $\frac{3}{8}$ in. round. This is intended to take the two or three zinc baths found in most homes. Its construction and making are obvious.

Handles.—Iron $\frac{3}{8}$ in. round. These serve for shovels and the like. In bending the ring a suitable length should first be bent at right angles. The shaft should then be cooled, and the ring portion quickly heated, so that the part to be bent is soft and is supported by comparatively cool and hard metal.

Coal Tongs (Plate VI).—Iron $\frac{3}{8}$ in. square and spring steel 1 in. × $\frac{1}{16}$ in. The first process is to thicken the end by striking sharply endwise, cooling all but the end. The gripping end is then flattened out fan shape, trimming up if needed with the ball pane of the hammer, while the side of the fan rests on the suitably curved part of the beak of the anvil. The twist needs a vice for holding and a spanner for turning. The difficulty is to produce two similar twists. They should be made when the iron, first well heated, cools down to dull red, and care should be taken to make the distance between vice and spanner equal each time: the spring is drilled, filed to shape and riveted in place, and then bent cold over a convenient block.

Cold Chisel.—Tool steel $\frac{3}{4}$ in. octagon. Tool steel must not be overheated nor yet worked too cold, and so a warning must be given that overheated steel becomes iron of inferior quality, and that splitting will follow hammering cool steel. Such tools as this are usually hardened and tempered in one operation. The

end is heated to moderately bright red, and then hardened by dipping about 1½ in. into water. Enough heat is retained in the rest of the tool to re-heat the end, and meanwhile the surface is vigorously rubbed with grit stone to brighten it sufficiently to see the colours. Cool finally at purple-yellow. Finish by grinding.

Lathe Work.—The infinite adaptability of the lathe, its appeal to the mathematical type of mind, its value to the adolescent whose muscular control is temporarily diminished, its service by widening constructive possibilities, its use of the ear and the sense of vibration, its exaction of the utmost of resource, can only be mentioned here. It is well to commence lathe work with a job which involves a fair reduction of the material, so that the strangeness of it all has vanished before working to size comes in. Such jobs as making milled head screws for wing compasses are very suitable.

The inter-relation of diameter of work, kind of material and speed of rotation should be made clear and the way metal can be removed with a well-ground tool, properly set, should be shown.

Poker Handle (Fig. 8).—Mild steel 1 in. round. This is a "between centres" job, and a length sufficient for six or seven handles should be taken. The ends are filed square, and the centres found and marked with a centre punch. The bar is then spun in the lathe and a piece of chalk held so that the eccentric part is marked. The centring is then corrected and tested again. When reasonably correct a small short hole is drilled at each end, and also countersunk. The small drills which perform both operations are economical and convenient. The heavy turning is done by means of the slide-rest, using hand tools for the curves. Some care is necessary when cutting off. It is seldom wise to allow boys to cut right through with turning tools. It is better to reduce, saw off, and finish with a file.

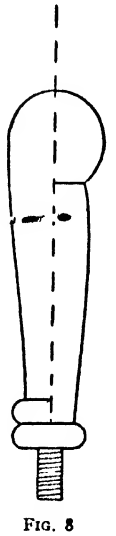


FIG. 8

Rivet and Washer.—Mild steel ¾ in. round and ¾ in. × $\frac{3}{16}$ in. The washer is marked out on the flat bar, the hole drilled, the piece cut and filed to shape, and one side filed flat and smooth. The ¾ in.

steel is held in the self-centring chuck and turned down to a driving fit for the washer, which is driven on without removing the work from the lathe. By careful tapping the flat face of the washer, which is towards the chuck, is made to run true, and the washer is turned, faced, and chamfered. The rivet is then turned to diameter, cut off, reversed in the chuck, and faced and chamfered.

Opisometer (Fig. 9).—Brass rods $\frac{3}{8}$ in. and $\frac{3}{16}$ in. round, and $\frac{1}{8}$ in. sheet brass. The sheet metal part is made first, and the holes drilled, those for the screw being both tapped at one operation. The $\frac{3}{16}$ in. rod should be cut long enough for both handle and screw, and the portion for the screw turned to diameter and screwed before cutting off. A fine thread is desirable, but $\frac{1}{8}$ in. Whitworth will do.

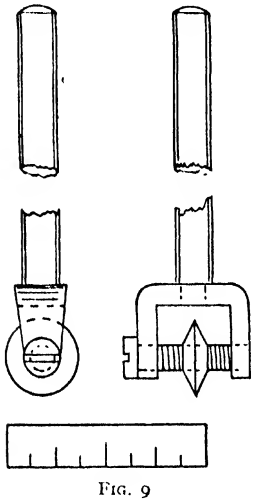


Fig. 9

The $\frac{3}{8}$ in. rod should be chucked next, its end squared, and the piece for the wheel necked down. Next the hole should be drilled, the start for the drill being made with a hand tool and the drill being held in a chuck carried by the loose headstock. The tapping should be done with a tap similarly held, but the headstock must be free to slide and follow the tap. Then the wheel can be turned to shape, leaving the diameter a little full. The periphery is "knurled" or "milled" with a wheel carried in a hand tool, and then finished to size, the aim being to make its circumference exactly 1 in. If the cutting off is done carefully, the wheel will need no other work, but if necessary a piece of metal may be turned and screwed so that the wheel can again be put in the lathe. The handle has an end turned down to fit the hole in the frame, and left long enough for riveting. The other end is neatly rounded. Two or three knurled rings on the handle improve the appearance.

Plumb Bob (Fig. 10).—Steel tube $\frac{5}{8}$ in. × 16 G. mild steel $\frac{3}{4}$ in. diameter. A piece of steel 15 in. or 16 in. long is taken and centred.

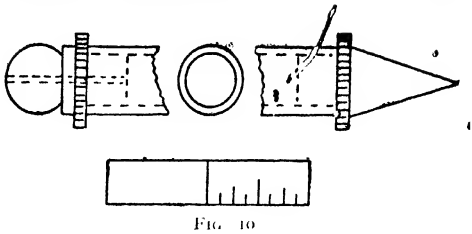


FIG. 10

A piece long enough for one of the ends is rough-turned to shape, and then the portion to be screwed is reduced to size ready for screw-cutting and further reduced just at the shoulder. The wheels are then set for the pitch required (24 or 26 per inch), and the thread cut with a vee tool, and finished with a chaser. The end is then cut off, the bar re-centred, and the other end of the plumb bob formed. The tube is now taken in hand, and carefully centred in the chuck. Its end is then trued and an internal screw formed in it to fit one of the ends previously prepared. This screw thread is used to hold the end while the latter is turned to a finish. The tube is then reversed, and its other end threaded, and the same procedure followed. The pointed end is turned with the slide rest set to the required angle. The hole for the string must not be forgotten. Finally the tube is filled with lead.

Pre-vocational Work.—Towards the end of school life one becomes aware of those pupils who are likely to enter metalworking trades or metal-using professions. Without relaxing grip over the educational and cultural side of the work, a considerable amount of useful work can be done. The requirements as to drawing and note-taking should be stiffened for these pupils, and the standard of work raised. Extra time can be justly asked for, and particular attention focussed upon the amount of work turned out. Probably the most profitable kind of work is found in making some of the hand tools found in an engineer's kit. In addition to those described, punches, chisels, gauges, callipers, and so forth may be made.

Surface Gauge (Plate VI).—Cast iron base, mild steel $\frac{5}{16}$ in., $\frac{1}{2}$ in. and $\frac{3}{4}$ in. diameter, $\frac{1}{8}$ in. cast steel wire. The base is planed or filed, except for its upper surface, which is turned when the base is in the lathe for drilling. The hole is then turned conical, the lower part of the milled nut being afterwards turned to a similar taper. These short cones are produced by setting the slide rest out of parallel, as is shown in Plate VI. *Making the*

column and clamping block is straightforward work, the drilling across of the latter requiring considerable care to get the hole central. When all the parts have been made and assembled, they are taken to pieces again, and the bottom and sides of the base carefully scraped to a surface plate. The surface plate (an accurately plane cast iron plate) is smeared with a little red lead and oil, and the surface which is to be scraped is pressed on it. The high places are marked by this means, and are then reduced by means of a scraper, readily made by grinding the teeth off the end of a flat file, and grinding the end at about 75° with the first grinding. This testing and scraping is repeated until the marks are found all over the surface

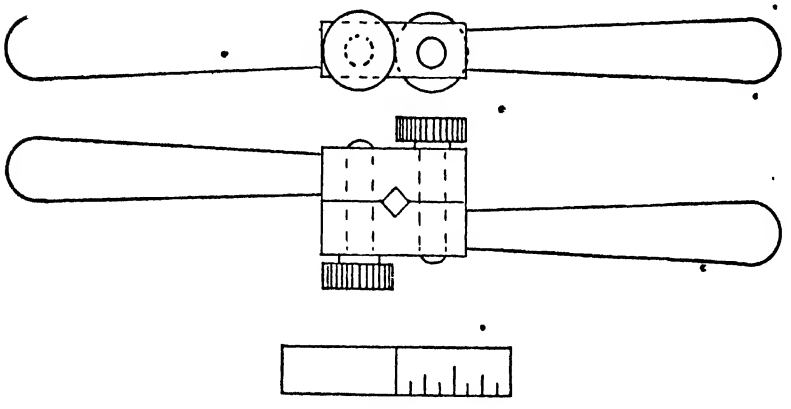


FIG. 11

Tap Wrench (Fig. 11).—Mild steel $\frac{1}{2}$ in. square. This involves turning long tapers, for which the loose headstock is set over, so that the axis of the work is no longer parallel with the bed of the lathe. The drilling needs care, and it should be seen that the pupil understands the difference between the clearance holes in one piece and the tapping holes in the other. The square opening for the tap is first drilled, and then filed square. After all is cleaned up, and polished, the parts which will grip the tap are heated bright red, and dipped into yellow prussiate of potash, or one of the commercial case-hardening mixtures. This is repeated several times, and finally the ends are quenched in water. This has the effect of hardening the surfaces

Depth Gauge (Fig. 12).—Steel plate $\frac{1}{8}$ in., cast steel wire $\frac{1}{8}$ in., $\frac{5}{16}$ and $\frac{3}{4}$ in. round mild steel. The shaping and bending of the plate needs no remark, nor does the making of the depth rod. In making the screw the hole is drilled first, then the rod turned to size and screwed, and last, sawn off, and the end faced. In cases like this the nut should be secured against loss by burring the end of the thread, by a small hole and pin, or by sawing a little way along the axis of the screw and spreading the halves apart.

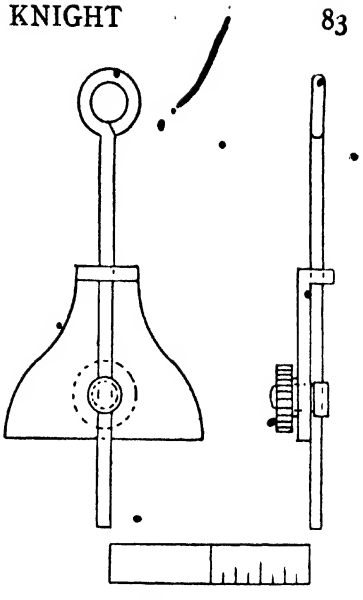


FIG. 12

Try Square.—Mild steel $\frac{3}{4} \times \frac{3}{8}$ in., spring steel $\frac{3}{4} \times \frac{1}{16}$ in. This is a simple problem and a most difficult one. The surfaces of the stock are, in turn, filed flat, square, and parallel. Spring steel usually comes so well rolled that the broad surfaces need very little work, but the edges need filing straight, square, and parallel. The real difficulty comes in sawing the slot. Lines are scribed showing the limits of the cut, and then a vee cut is made with a triangular file. Special slotting saws may be obtained, or as a makeshift two ordinary blades may be put in the hack saw frame to make a wider cut. The vee cut is a great help, but the sawing needs care and skill, and it is well for the stock to be left over length in case of non-success at the first attempt. The blade of the square is held in place by two or three rivets. The hole for one should be drilled and countersunk, and the rivet fixed, and the blade then tapped truly square. The other holes can then be drilled, and the other rivets closed up, testing frequently for any movement.

Advanced Problems.—Larger and more complicated work becomes possible as skill and strength keep pace with enlarging ambition and extending ideas. It is desirable that every boy should, either singly or as one of a group, render service to the

school, and when possible should close his school career with some distinctive and worthy piece of work. A few such pieces of work are described and illustrated.

Punching Bear (Plate VI).—Cast iron body. Mild steel 1 in. and $\frac{1}{2}$ in. round, cast steel $\frac{5}{8}$ in. round, silver steel $\frac{1}{4}$ in. round. The casting is chucked on the faceplate, and a $\frac{5}{8}$ in. hole bored through the upper part and a $\frac{1}{2}$ in. hole through the lower part. The face around the lower hole is trued up, for the neck of the die to rest upon. After the casting is taken from the lathe, the upper hole is tapped $\frac{3}{4}$ in. Whitworth. The screw is next taken in hand, and is turned to dimensions between centres and screw cut to a nice fit. The end is then supported in the fixed steady rest, while a $\frac{1}{4}$ in. hole is drilled for the punch, which is made of silver steel, turned to size at the end. The die is turned in the chuck and drilled to the size of the punch, a larger drill being afterwards put through within $\frac{1}{8}$ in. of the top surface. Tool steel must revolve slowly, and be freely lubricated during turning. Both die and punch have flats filed upon them to take the fixing screws and to prevent them from rotating, and are then hardened and tempered dark yellow. These punching bears are economical of time and of small drills. They can be used, too, for a good deal of pierced work.

Teaching Model Micrometer (Plate VI).—Aluminium frame, $1\frac{1}{8}$ in. round steel, $1\frac{1}{8}$ in. × 16 G. steel tube. It is difficult for a boy to see the thread and grasp the working of an ordinary micrometer, and this large model is very useful for class teaching and as a measuring instrument in the woodwork room. The frame is held in the chuck by the barrel end, and a $\frac{5}{8}$ in. hole drilled right through, and afterwards tapped $\frac{3}{4}$ in. Whitworth. The screw is next made, and is arranged to serve as a mandrel to carry the frame in the lathe while the barrel is turned to size. When the barrel is turned, a roughing tool is turned on its side, and the lathe used as a shaping machine to extend the curve of the barrel along the part of the frame it adjoins. With a pointed tool, the reading line is cut along the barrel, and by using the guide screw of the lathe, lines can be marked round the barrel each 1 in. The head of the screw is made a tight fit for the tube which forms the sleeve, and the two are fixed together by a countersunk screw.

By using the lathe as a dividing engine, the end of the sleeve is divided into ten parts. A short length of screw is turned to a jamming fit to serve as the anvil, and the end of the main screw is carefully squared. All that remains is to adjust the zero by the anvil screw, and to stamp the pitch of the screw ($\frac{1}{10}$ in.) on the frame.

Metal Finishes.—Some protective treatment of the surfaces of most of the products of the metalwork room is desirable. Tinned plate is already well protected. Bright steel surfaces may be kept permanently greasy or they may be varnished with celluloid (old photographic films) dissolved in amyl acetate. Brass should be polished with emery and commercial metal polish, cleaned from all traces of the polish and lacquered. The metal should be hot enough to dry the lacquer quickly, but not hot enough to make the brush stick. Practice is the only guide and the cheek the best thermometer.

Copper, also, can be lacquered, though it suits some work and some tastes to polish thoroughly, and then to leave time and handling to produce a patina.

Brass and copper can both be darkened by dipping while hot into a solution of "butter of antimony." A finish beloved of instrument makers is then obtained with green lacquer.

Forged work may either be filed bright or given a coat of dead black.

Materials.—The question of materials is an important one. By exercising some care in deciding upon the dimensions of the various objects ordinarily made, the number of different sections of steel, for example, can be kept down, but convenience and economy must not be pushed to the point of entailing needless labour—"donkey work," to use the expressive workshop phrase. There is nothing to be gained, and much to be lost, by giving a boy material which involves perhaps an hour of dull filing or chipping or turning before the intelligent part of the work comes in sight. Such a waste of human material would not be tolerated in a factory, and surely ought not to be in a school.

The teacher should familiarise himself with the main resources of metal supplies, and should, too, see that his pupils know what can be obtained and where.

Most iron and steel merchants issue a list of the sections they stock. The range is amazing. Flat steel can be obtained from $\frac{1}{8}$ in. × $\frac{1}{16}$ in. to 5 in. × 2 in., round steel, bright and straight, from $\frac{1}{8}$ in. to 6 in. diameter accurate to size within ·002 in., square and hexagon steel in every necessary size. Sheet steel is stocked in convenient thicknesses in widths from 6 in. to 4 ft., and varying between tool steel on the one hand to a steel which rivals copper for beaten work. Steel tubing of excellent interior and exterior finish is supplied from $\frac{1}{2}$ in. and less to 6 in. and even more.

Brass and copper, in addition to being obtainable in all reasonable thicknesses in sheets 4 ft. × 2 ft., can be had in strip form, and both sheets and strips come hard rolled or annealed and soft.

Brass and copper rods and tubes are procurable in an astounding variety of sizes. Gas piping, which labours under an undeserved slur as a constructional material, is kept by most good ironmongers, in lengths ready screwed, and in combination with sockets, elbows, tees and flanges makes the construction of the framework of, for example, a windmill a quick and sound job. Tubular construction requiring a better appearance can be made by utilising cycle and motor lugs in combination with steel tubing.

The lengths of "silver steel" (bright tool steel) now stocked by nearly all large ironmongers and tool shops are useful both for making drills and punches and as small shafts. For this latter purpose, it is perhaps better to go to a clock material dealer, as the straightness of the pieces can then be relied upon.

Clock materials are often a help where toothed wheels are needed to finish a job. Ball bearings, such as are supplied by Hoffman's and others, render possible the making of pulleys, etc., of very high efficiency, and it may be noted in passing that the makers of such components as these are generous with their help in suggesting suitable methods of applying their manufactures.

There are a number of firms which specialise in supplying gear wheels, bearings, castings of engine and machine tool parts, etc., in sizes and of types suited to manual training needs. They also make castings to any pattern of smooth finish and easily workable

iron. Addresses of such firms can be found in the *English Mechanic* and the *Model Engineer*.

Catalogues of all kinds can be had at the expense of a postcard and a courteous request. They should be carefully kept and fully used. Some steel manufacturers publish hand-books dealing with the applicability and treatment of their steels, and one or two issue colour charts for tempering.

Tools and Equipment.—Anvil and swage block, four broaches and handles, blowpipe and foot bellows, wing compasses, inside and outside callipers, vernier callipers, micrometer callipers, chipping chisels, drilling machine and chuck, hand drill stocks, twist drills, forge, tongs, hardies, flatters and sets, hammers, chaser's hammers, files, hacksaws, lead ladle, mallets, cutting and round nose pliers, centre and repoussé punches, taper reamers to ½ in., parallel reamers, rules, squares, snips, bench shears, surface gauge and surface plate, stocks, dies and taps ⅛ in. to ½ in., tinman's stakes, soldering irons and stove, vices and hand vices, adjustable spanner, 4½ in. or 5 in. screw-cutting gap-bed lathe, self-centring chuck with two sets of jaws, independent chuck, drill chuck to fit tailstock, tools, hand tools and tool holders, carriers to 1½ in., screw chasers, knurling tool, vee block, number and letter stamps.

This forms the nucleus of the equipment, and the cost would be about £80. Periodical extension would be needed after the most profitable direction of work had been found. A second and simpler lathe is desirable, and a small shaping or planing machine. A second light drilling machine might be made. Such a one is shown on Plate V.

The cost of replacement and repairs is about £2 per annum, and of materials per boy about 3*s*.

Storage of Materials and Tools.—The ideal method of storage of materials and tools has yet to be devised. Tools should be arranged in racks where possible. Drawers are preferable to cupboards, but as the weight carried is considerable, should be "stopped" so as to run no risk of being pulled out too far. Coils of wire should be bound round in three or four places. Sheet metal problems should be planned to fit without needless waste into the commercial 4 ft. × 2 ft. sheet of brass or copper. If the main stock is locked up, economy in cutting out can be insisted on.

Rod metal may be cut to 4 ft. lengths, and bundled with stout wire ties, with a view to securing that only one length is in cut at a time.

BOOKS OF REFERENCE

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LVI. AN EASY INTRODUCTION TO WOOD CARVING

By ISAAC J. WILLIAMS

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Its Special Educational Functions.—It is quite as vital to true education to develop artistic instincts as it is to develop constructive instincts, and suitable subjects should be systematically employed to this end. Up to the present time wood carving does not appear to have occupied a sufficiently important position in educational handwork as a means of developing the æsthetic powers in children. This is astonishing and regrettable, since carving cultivates concurrently to a great extent manual dexterity and artistic perception. It was one of the first methods of artistic expression, and it forms a fitting and necessary accompaniment to a course of ordinary woodwork.

Wood carving is artistic and decorative, as opposed to the rigidly constructive and mechanical nature of much of the ordinary woodwork, and therefore gives more scope for æsthetic individuality and invention, inasmuch as the pupil has ample opportunities for the expression of his imagination or fancy together with a freedom of interpretation, which cultivate self-reliance and decision to a very marked degree. The limits of material and tools, too, have a wholesome restraining influence.

Aim and Scope of the Exercises.—The exercises in the following course are chosen with the view of presenting in regular order, to the beginner, natural and technical difficulties which are easily overcome. From these examples he will soon realise what to aim at and avoid when attempting more advanced and original work. They embrace sufficient variety of form, relief, and tool manipulation, without needless repetition, are arranged with due

regard to sequence, and made sufficiently interesting to ensure steady progression. Each one is a problem designed in such a manner that the mental and physical energies may not be unduly taxed.

The method of presenting innumerable patterns has been deliberately avoided, as such a course would only confuse the beginner. The chief requirements of a suitable and instructive course should be regarded as the selection of exercises embracing the main features and operations calculated to cultivate good taste, and also to give that necessary variety of tool operations which will secure strength, character, and breadth of treatment, without sacrificing artistic qualities. A well-chosen pattern, or a simple, tasteful design well placed, possesses far greater artistic value than an intricate or over-elaborated one.

Some Guiding Principles.—The teacher should endeavour to gauge the capacity of his pupils, and work accordingly; always encouraging individuality. The pupils must learn that plain spaces have a decorative value; and they must realise that there is such a thing as the fitness of decoration; that although it may look pretty to carve the whole of a table-top, it is not fitting; a border decoration is quite sufficient and infinitely more artistic. Again, it is obvious that the carving should not be in high relief, if applied to a horizontal surface. It is a common error with beginners to cover every square inch of a surface with ornament.

It will be noticed that most of the exercises in the course are conventional in form. This is necessarily so, since they are evolved from natural tool operations, which is a perfectly sound method of procedure, both from an educational and artistic point of view. It will be readily recognised that what may be called the technique of every process has its limitations, usually governed by the tool and material used; and this should never be hidden by mechanical finish. There should always be the touch of the tool in the work, which, when completed, should not be suggestive of stamped leather or beaten metal. The inability to recognise these limitations is the cause of a considerable amount of trouble in most practical work.

If it is found that, in spite of all efforts, the work is not progressing satisfactorily, it will be well to pause and consider whether

the pupils are not attempting the impossible, and have already got beyond the limits imposed by the simple laws of the subject. If, for example, the pupils are unable to get nice clean cuts for the rosette pattern (Plate IX A), though the tools are sharp, they have got beyond the cutting power of the gouge. The cuts are too deep, and they have exceeded the limits of both tool and material. Again, supposing it is desired to carve, say, a sycamore, or vine leaf from nature (see illustration, Plate XIII), it would be folly to attempt to express all the delicate venation and serration, exactly as it appears in the leaf. A carver can never succeed in producing in wood a perfect representation of nature, for he is limited by his material, and consequently must generalise. This generalisation of form is in itself an excellent mental training.

Its Suitability for Schools.—Wood carving can be taught with great advantage to boys and girls on the lines indicated in the following course; they can commence this course at about the age of twelve. Since it develops the æsthetic element in the child's nature without any undue physical exertion, it is quite suitable for girls. It provides ample scope for the cultivation of accurate and mathematical measurement in setting out and planning the exercises, and a good training in drawing, modelling, and light and shade. Opportunities for connecting the work with history and the historic development of ornament constantly arise, in a manner likely to interest and stimulate the intellect; the pupils are taught to appreciate and understand the beauty, fitness, and practical utility of decorative forms, and have ample opportunity of noticing their application on buildings, furniture, etc. Excellent artistic training is afforded by drawing plant life from nature, abstracting and generalising the forms suitable for expression in wood, and thus learning to appreciate, and rightly value, manual and artistic dexterity.

Moreover, it is work that can be easily and profitably continued at home when the days of school life are ended, an important element in training. Plain wood articles of furniture can be purchased cheaply, and their value increased by suitable decoration, thus giving additional interest to possession. No costly tools or appliances are required, not even a work-bench, as an ordinary kitchen table will serve that purpose. Pupils should

be encouraged to make drawings of suitable objects, and taught how, and where, to apply suitable ornament, thus cultivating a knowledge of style and character as well as design.

Design.—It is highly important for original work that some knowledge of design be acquired. It is not proposed to treat this branch of the work exhaustively, since this would be out of place; and doubtless the beginner will have gained some knowledge of the subject, in dealing with ordinary drawing, and in the illustrated exercises for the practical work, particularly if the instructions for setting out have been closely followed. The following exercises have been arranged progressively, and are consequently evolutionary. In design, the first simple principles are (*a*) repetition, (*b*) arrangement. Originality should follow naturally. It will be seen how the first exercise may be arranged to form a simple pattern or design, and utilised to decorate the bread-board (second exercise, Plate VII).

The illustrations of simple tool cuts arranged to form patterns are also suggestive of the method to adopt by beginners. For more serious work it is a good plan to map out geometric spaces for masses, and then link them up by line. By this means the pupils will at least secure order, and the elements of ornament will be arranged on a definitely organised plan. They certainly cannot proceed very far with the development of their own ideas, unless they cultivate, in the first instance, the law of order and arrangement, which is the very essence of the subject.

Since the design when carved will be in relief, it will be very helpful if the pupils first make models from drawings, in clay or plasticine. They will then be in a better position to judge the effect of their effort, and alterations are easily made, without any waste of time or material.

If the pupils have any knowledge of light and shade, they may wash in their drawings with sepia, thus suggesting solidity. This is a much more effective method than mere outline, which is often most misleading. Charcoal drawings on common brown paper, using white chalk for the lights, is a very rapid and excellent method of forming an idea of the general effect of a design. Plenty of practice in this direction can be obtained by making drawings of the simple exercises which have already been carved. In any

case, it is best to make preliminary drawings with charcoal, for a pupil is more likely to evolve something with this medium than with the hard point of the lead pencil. The lead pencil is much too frequently used for free drawing. It is a purely mechanical instrument, and should be treated as such in our elementary and secondary schools.

First Exercise.—MODEL 1A, Plate VII.—*Aims:* Accurate setting-out on timber; preliminary exercise in the use of the gouge; limitations of material and tools. *Material:* Yellow pine. *Dimensions:* 12 in. × 2½ in. × ¾ in.

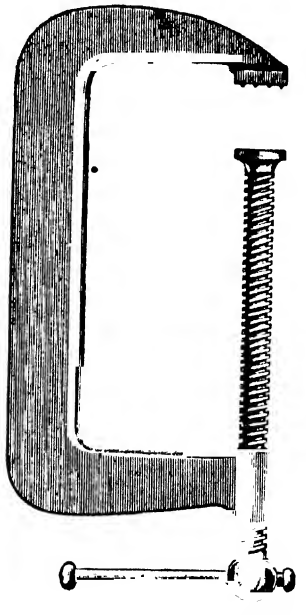


FIG. 1.—G CRAMP FOR SECURING TIMBER TO BLOCK

Procedure.—1. Set out surface of timber as indicated in drawing, using steel rule and try square. 2. Firmly fix timber to bench by means of a "G" (Fig. 1) cramp or wood buttons; or secure in vice. If a cramp is used, place a thin piece of wood between the surfaces of the timber and the cramp to prevent injury. 3. Commence at the nearest end by placing the gouge so that the corners coincide with the first cross line; hold it upright and firmly in the right hand, with the thumb on top of the handle; steady it with the left hand and sharply press, leaving the shape of the tool impressed in the wood. Next make a horizontal cut, commencing at the surface of the timber as indicated, and gradually sloping to meet the vertical impression; repeat this simple process of vertical and horizontal cutting until down to the required depth, taking care that the vertical cut is always a trifle deeper than the horizontal, so that the chip will clear itself naturally. Before this section of the exercise is completed the pupil will have discovered the object of the repeating pattern, and gained sufficient confidence to make the last repeat with two or three clean cuts.

MODEL 1B.—This is produced by similar cuts, but demands more attention to form than 1A. Note the elliptical outline and circular centres. Should rashness or carelessness have been developed through the confidence gained in working 1A, the centres will collapse, through excessive pressure in the vertical cuts.

Second Exercise.—BREAD-BOARD.—*Aims:* Application of gouge cuts in first exercise to form a pattern; spacing; introduction of the V, or parting tool, and small gouge. *Material:* Sycamore or Oak. *Dimensions:* 12 in. × 12 in. × 1 in.

Procedure.—Draw directly on the board, a line passing through the centre and parallel with the grain; draw another line passing through the centre and at right angles to the first one; divide up the spaces as indicated in the diagram, using a strip of strong paper to draw the lines on the bevelled margin of the board which is to contain the pattern. A compass may be used as a gauge to draw the concentric circles, limiting the space occupied by the gouge cuts. Make the large gouge cuts in exactly the same way as the first exercise, but note by reference to the section that each cut when completed will be horizontal and not sloping, as in the case of the previous example.

Next make the short cuts with the V tool. To prevent *overcutting*, first press the corner of the small flat gouge into the board where the cut made by the V tool should end. The small circular cuts beyond the V are made last of all. Finally remove the pencil lines with a hard rubber.

Already it will be noticed that the sequence of tool operations is carefully described. I do not propose to give reasons for this policy which is adopted throughout, because I am convinced that the student will, or should, quickly realise, when working the exercises, why such instructions are given.

The V or Parting Tool.—This is the most difficult tool to sharpen and to use, but if properly set is most useful, and cuts very easily. To beginners the very sight of the V tool seems terrifying. In imagination, and very often in reality, they see all manner of nasty gashes meandering over their work in endless confusion. The exercises are carefully arranged in this course, so that the student may be initiated into the use of the

parting tool as quickly as possible, and be taught to overcome what appears to be a natural antipathy towards it.

It must be said at once that freedom of execution and artistic effect cannot be expressed without a complete mastery of the V tool. Later on in the course it will be in constant use, and may be looked upon and used as a drawing instrument, of as much importance to the carver as the lead pencil is to the draughtsman or the sable brush to the painter. With a little care in setting, it becomes quite tractable. It is really two chisels joined together to form a V, and must be treated accordingly. Fig. 2 shows an enlarged section of it. Particularly note the thickness of metal at A compared with B, which must be taken into account when sharpening.

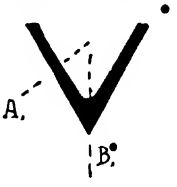


FIG. 2

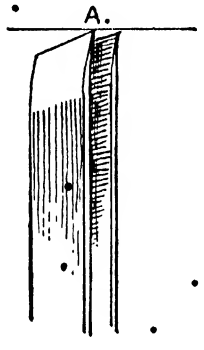


FIG. 3

This tool will be found to cut very easily and be under perfect control if the following instructions are carried out. 1. See that the cutting edge is not quite at right angles with each side. Let it slope downwards slightly from the top edge, as at A (Fig. 3). Next grind each side exactly like an ordinary carpenter's chisel, taking care that the intersecting or central line maintains its natural direction when viewed from the back. Then sharpen each side on the oil-stone. Hold the tool flat on the grinding surface in order to avoid having two bevels; sharpen the inside of the tool with the wedge-shaped slip, which should fit it; and finally strop both sides. For the inside of tool, one edge of the strop may be cut on a bevel to fit it, or a smaller and separate leather may be used for the purpose, bevelled and prepared with emery flour and lard. In spite of every care, there may be found a little projecting point caused through the impossibility of maintaining a sufficiently fine edge on the wedge-shaped slip; remove this by using the slip on the outside edge, very slightly and evenly

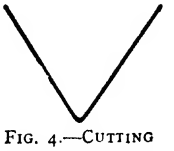


FIG. 4.—CUTTING EDGE OF V TOOL

rounding it to suit the inside (Fig. 4) and strop again. (See Illustration of V sections.)

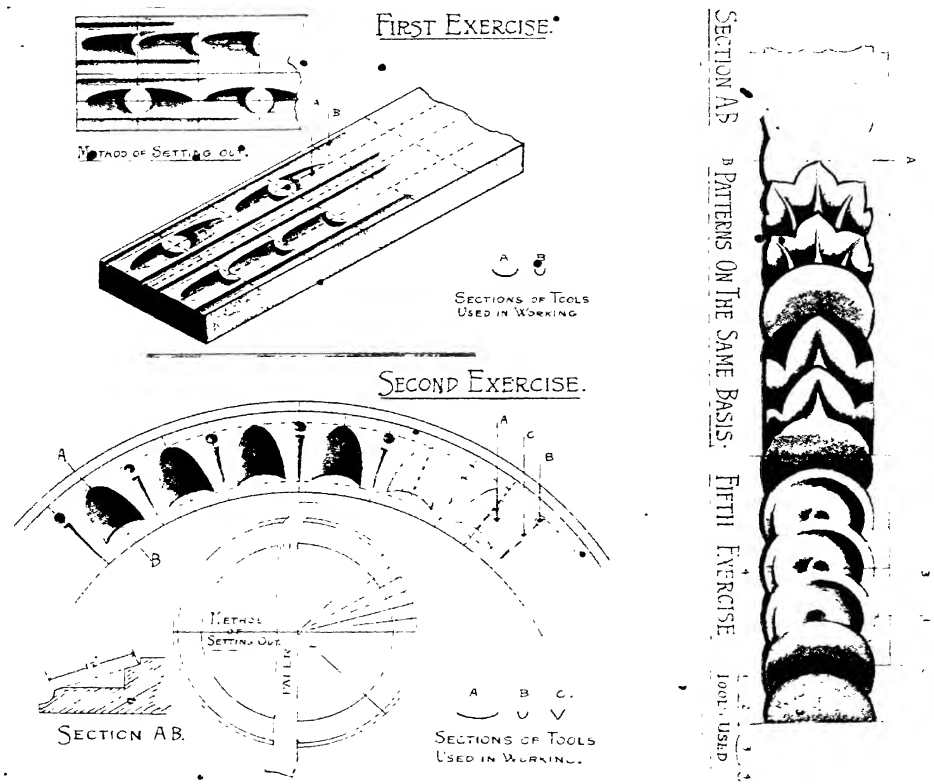
Third Exercise (Plate VIII).—SIDE OF A BOX.—*Aims:* Setting-out on timber; pattern drawing directly on the wood; straight gouge cutting in two directions; free use of the parting tool. *Material:* Satin walnut; *dimensions*, 14 in. × 5 in. × ½ in.

Procedure.—It will be best to first set out the rosettes geometrically as indicated in the illustration, taking care to notice that their centres do not lie in the centre line of the timber; next proceed to make the radiating cuts, commencing near the centre of the figure and working away from it, until the circle is reached upon which the larger semicircular ends are constructed; then work in the opposite direction to meet the first cut—these cuts should be repeated until your gouge exactly fits the drawing. The worker must be careful that the intersecting cuts exactly coincide; this is the chief point in this section of the exercise.

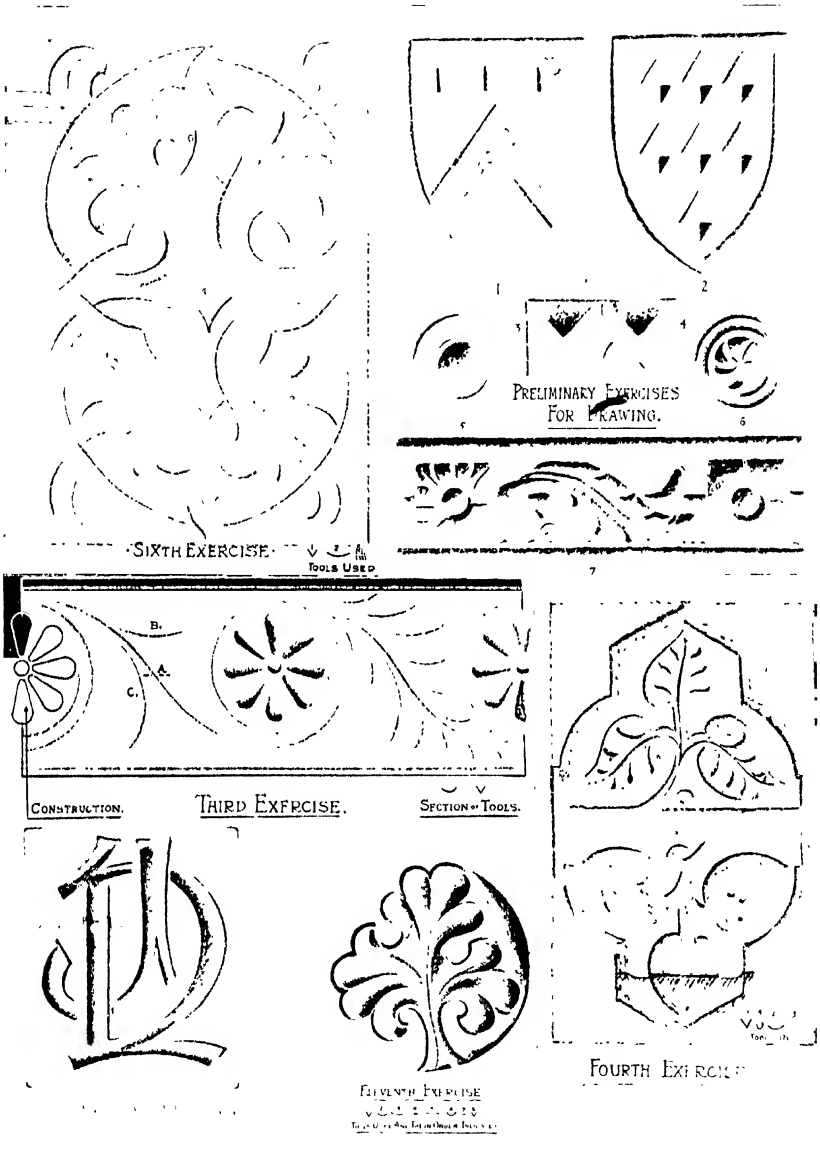
Next cut out the centre with a small gouge, holding it at an angle of about 45° and making a circular scooping cut. Then proceed to draw, freehand, the connecting curves—a sharpened piece of chalk is best for this. Note the method in the diagram for drawing the radiating side lines; begin with B and C, and then fill in the remainder. When making the cuts with the V or parting tool, be careful to avoid a mechanical cut of even depth and thickness. Begin nearest the rosette with a light, fine cut, increasing the depth by extra pressure upon the tool until the centre of the curve is reached, and then gradually decrease it until the cut is completed (see the worked exercise on Plate IX).

Fourth Exercise (Plate VIII).—WALL BRACKET.—*Aims:* Working drawing on paper; transferring to wood; outlining with parting tool; curves of varying direction; setting in and grounding out; short, sweeping cuts with small gouge in two directions. *Material:* Oak or Bass. *Dimensions:* 10½ in. × 7 in. × ½ in.

Procedure.—Since this exercise contains the rudimentary principles of relief work, *e.g.* setting in and grounding out, an illustration of the model is given clearly indicating the stages of working (Plate IX B). First set out on paper the shape of the bracket; only one-half of the ornament need be drawn, the other



WORKING OF THE FIRST, SECOND, AND FIFTH EXERCISES



DRAWINGS FOR WOOD CARVING

can be transferred with tracing paper. Pin the drawing to the prepared piece of wood, and transfer it by means of carbon paper; then proceed with the first stage of the work, *viz.* outlining the leaves with the V tool and the shape of the bracket with the gouge. This outlining of pattern should be of even depth. Next, set in, which consists of a series of cuts made with a fairly round gouge at right angles to the pattern.

Second stage: ground out, that is, make the surface of the ground smooth with a flat gouge, by removing the ridges left by the round gouge. It will probably be noticed that the flat chisel is not included in the set of tools; the reason is made manifest in this exercise. It is quite impossible to make a smooth ground surface with a chisel, because the corners dig into the wood. The flat gouge overcomes this difficulty, and at the same time gives a very slightly modelled surface, which is much more pleasing and artistic than the mechanical surface left by the chisel. The cuts indicating the veins of the leaves explain themselves in the partly worked exercise shown on Plate IX B.

Fifth Exercise (Plate VII).—COIN OR DISC BORDER.—*Aims:* Setting out of imbricated or overlapping pattern; simple relief expression, involving new gouge cut. *Material:* Bass wood. *Dimensions:* 12 in. × 2¼ in. × ¾ in.

Procedure.—Set out the overlapping circles with compass directly on to the wood, then remove the ground exactly as indicated in the partially worked exercise illustrated (Plate IX C). Notice that the timber outside the line tangential to the circles is removed first; then the V-shaped spaces are removed by two small sloping and intersecting cuts, in order to weaken the superfluous timber, and avoid splitting the outside edge of the discs—apart from the actual modelling this is the important point of the exercise. Knowledge of how to easily remove any portion of timber, without damaging the part required for the ornament, must be acquired. This is a useful preliminary exercise.

Having successfully removed the ground, mark out the disc as shown with the small flat gouge. If a larger and rounder gouge will fit the curve, so much the better. Press in the tool vertically, but not too deeply to weaken the fibres of the timber; then cut down with the large flat gouge in a slightly sloping

direction to meet the vertical cuts of the small gouge; repeat both cuts until sufficient relief is expressed. Next, with compass, draw the second circle forming the band of the disc; then make a circular gouge cut forming the hollow in the disc with the tool indicated in the drawing; and finally make the smaller cut at the centre. This exercise should give a good knowledge of the elementary principles of relief, and values of light and shade.

Sixth Exercise (Plate VIII).—PANEL OR TRAY.—*Aims:* Pattern planning; free cutting of a varied outline with V or parting tool; simple surface modelling of conventional forms; punching to emphasise pattern. *Material:* Austrian oak. *Dimensions:* 18 in. × 12 in. × ⅜ in.

Procedure.—Set out the dimensions of the tray on paper and sketch in the pattern, carefully drawing one-quarter only, which will be quite sufficient for practical purposes, since the unit of design forms a reversed repeat. Should a careful drawing be made, as in Plate VIII, it will only be necessary to make a tracing of one-quarter, which can be transferred in the usual way with black carbon paper. The pattern being completed on the timber, next outline the whole of it with the parting tool, cutting fairly deeply. For this purpose use the mallet (Fig. 5), which comes into operation for the first time in connection with the parting tool. Very small and round curves must be cut with a gouge that fits them, leaving a cut similar in section to that made by the V tool. Be careful to follow the pattern accurately. Deal with the shortest curves first and finish up with the longest.

FIG. 5.—MALLET

Now commence the modelling, using the gouge indicated; begin with the band, and do not cut beyond the inside edge left by the parting tool. Then with similar cuts follow the direction of each part of the pattern, increasing the depth of the cut with the width of the pattern, so that a ridge, very like a vein, is left in the centre of the leaf-like forms as indicated in illustration on Plate VIII. Now a word of caution and advice: however sharp the gouge may be, portions of the ornament will be cut against the grain and the surface will not appear smooth and clean. In

working this exercise, a great deal will be learnt about perfect tool manipulation. Here is a simple rule for guidance: finish off the work by cutting in the direction of the grain. This is difficult for beginners to realise when the pattern takes varying directions; therefore remember to cut from the short towards the long fibres of the timber, as indicated by the arrows in Fig. 6.

After cleaning up your work, punch the background with a plain punch, as shown in illustration of the exercise. To get into

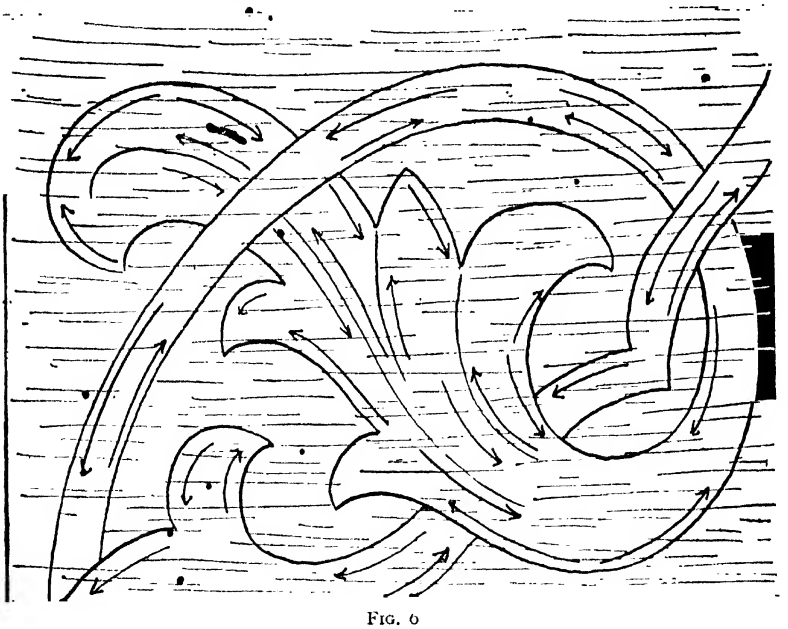


FIG. 6

the corners use a blunt french nail. Avoid punches having a fancy pattern, such as a star or acorn. Be careful to give the punch even blows with the mallet, and don't strike too hard or the timber will be bruised. Punching is resorted to for emphasising the pattern, and should only be used on shallow grounds, or when, as in the present case, no background is removed. When carving in fairly high relief, the ground should be cut clean and left plain. Too frequently, punching is resorted to in order to hide bad workmanship; therefore avoid it, excepting in the circumstances just referred to.

Seventh Exercise (Plate X): ROSETTE PATTERN, IN HIGH RELIEF, SUITABLE FOR A PANEL.—*Aims:* Setting out directly on timber, and drawing as the work proceeds; treatment of hollow and round surfaces; varied relief. *Material:* Bass wood. *Dimensions:* 8 in. × 8 in. × $\frac{7}{8}$ in.

Procedure.—Set out geometrically the pattern as indicated in Fig. 7. Cut the large circles with parting tool; and set in and

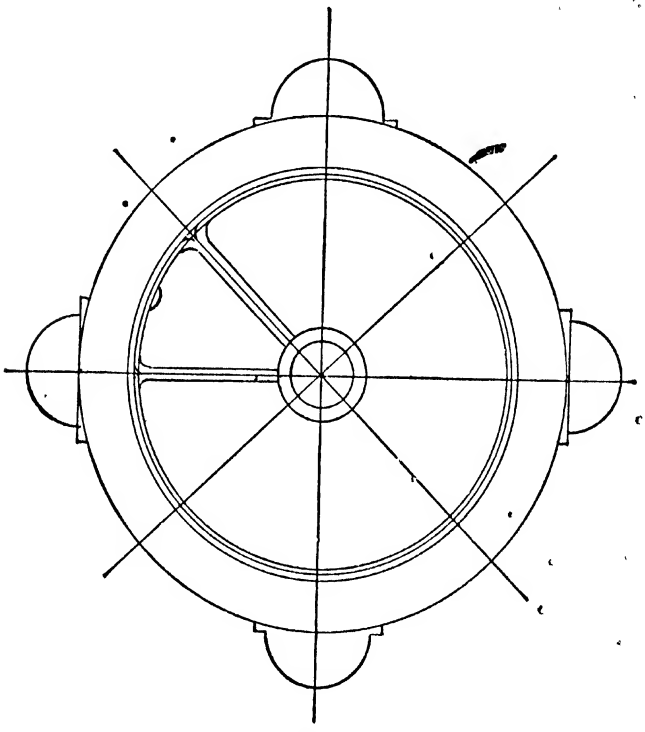
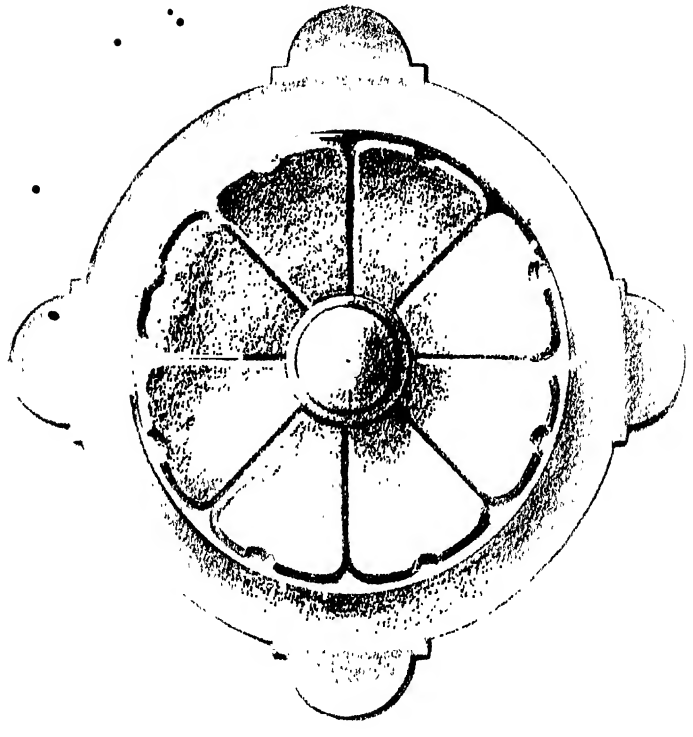


FIG. 7

ground out in the usual way until down to the depth indicated in the section. Next ground out to required depth all the pattern occupied by the leaves of the rosette, leaving the central boss and ring until (with the flat gouge) the saucer-like space occupied by the leaves is cleaned up (see Section, Plate X). The next step is to make the divisions of the leaves; this is done with the parting tool, the cut being equal in depth to the first large circular

WORKING OF THE THIRD, FOURTH AND FIFTH EXERCISES

PLATE X



SEVENTH EXERCISE

TOOLS USED.

WORKING OF THE SEVENTH EXERCISE

one. Then shape the leaves as indicated in Fig. 7, using a gouge that fits the curve; pressing at right angles to the extremity of the leaf; and removing the small pieces of timber by cutting with the small flat gouge in the opposite direction.

The centre boss should now be completed. Roughly shape it with the large flat gouge, and complete it by cutting with the inside of the largest round gouge—that is to say, work with the round side of the gouge upwards. The boss is the reverse of the leaves, therefore to model it, reverse the tool. Next cut the disc around the boss, which is beneath it and only slightly above the surface of the leaves. Finally, model the large disc outside the leaves, first of all removing the surplus timber with the large flat gouge.

Eighth Exercise (Plate XI).—CELTIC PANEL.—*Aims:* Grounding out spaces to accurate depth; interlacing. *Material:* Bass wood. *Dimensions:* 8 in. × 8 in. × ¾ in.

Procedure.—Set out on paper, and re-draw with instruments on timber. Roughly indicate with lead pencil the interlacing, in order to avoid mistakes in cutting; go around the whole of the pattern with the parting tool; set in and ground out. Some difficulty is likely to be experienced in removing the detached portions of the ground regularly, therefore make a depth gauge. A straight strip of timber, something like a flat ruler, will do, with a nail driven through the centre of the flat side, the point projecting to the required depth. Use this simple gauge as the work proceeds to test the depth of ground.

This particular example of interlacing has been chosen as it indicates very simply and clearly the principles underlying this class of ornament.

Particularly note that the circular band lies perfectly flat, and that it is the straight bands that interlace; therefore, after removing the ground to the required depth, at once cut the visible portions of the circular band to half the depth of the ground, totally disregarding the straight bands; *after* this is done, proceed with the interlacing, as indicated in the illustration, using the large flat gouge; finally, take off the sharp surface edges, in order that they may catch the light.

Ninth Exercise (Plate XI).—ARCHITECTURAL BORDER PATTERN.

—*Aims:* Historical; simple exercise in high relief showing strong light and shade; evolution of pattern. *Material:* Yellow pine. *Dimensions:* 12 in. × 2¼ in. × 1 in.

Procedure.—Set out the square spaces occupied by the square pyramids—which are the nail-heads of the Norman period—on the surface of the timber, and remove the ground forming the border of the moulding in exactly the same way as shown in the Coin Border (see Plate IX c). Then make a saw cut, not quite so deep as the ground, thereby dividing the squares, and convert the square prisms thus formed into triangular prisms as indicated in Plate XI. Convert the triangular prisms into pyramids, cutting from the apex downwards with the large flat gouge. Each side of the pyramids is then cut vertically with the large round gouge, and the curved spaces gradually removed with the small flat gouge down to the level of the ground forming the border of the pattern. The completed pattern is the so-called dog-tooth, frequently used in Gothic architecture of the twelfth century.

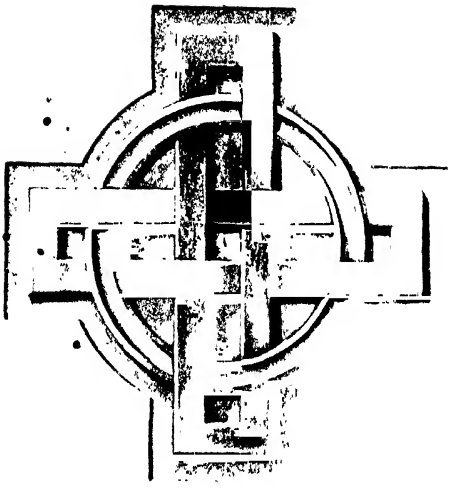
Tenth Exercise (Plate VIII).—MONOGRAM.—*Aims:* Letter cutting; showing suitability of form and treatment for wood carving. *Dimensions:* 10 in. × 8½ in. × ¾ in.

Procedure.—Design with charcoal and chalk on brown paper your own monogram or initials, choosing letters similar in character to illustration. Make a tracing and transfer on to wood; outline pattern with parting tool; set in and ground out to depth; model with gouges as indicated on Plate VIII.

The whole point in this exercise is to treat the subject in a manner entirely suitable to the process. This serves as a preliminary to the eleventh exercise.

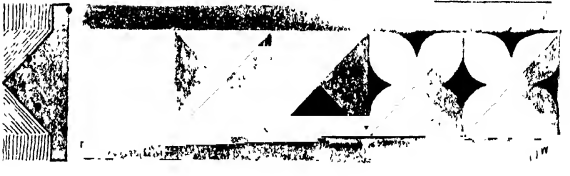
Eleventh Exercise (Plate VIII).—CONVENTIONAL LEAF FORM. —*Aims:* Variety of outline and surface; limited background; introduction of the roll cut. *Material:* Bass wood. *Dimensions:* 9½ in. × 9½ in. × 1 in.

Procedure.—Draw the pattern on paper and transfer it with carbon paper on to the timber; outline the whole of the pattern with the parting tool; set in from the circle and ground out to dotted line a saucer-like surface similar to Exercise VII. Next remove ground up to margin of pattern (dotted in diagram 8);



EIGHTH EXERCISE.

TOOLS USED



SECTION

NINTH EXERCISE.

TOOLS USED.

WORKING OF THE EIGHTH AND NINTH EXERCISES

EXERCISE ELEVEN—CONVENTIONAL LEAF FORM

cut out the centre of leaf occupied by the midrib nearly to depth of ground, using a round gouge; make the radiating cuts from the margin of the leaf as shown in Plate XII, taking care that the radiating ridges die away towards the centre. The pipes A (Fig. 8) are treated similarly, but are raised and rounded; they also die away towards the centre stem. Reference to *Fig. 8* and Plate XII should make the description clear.

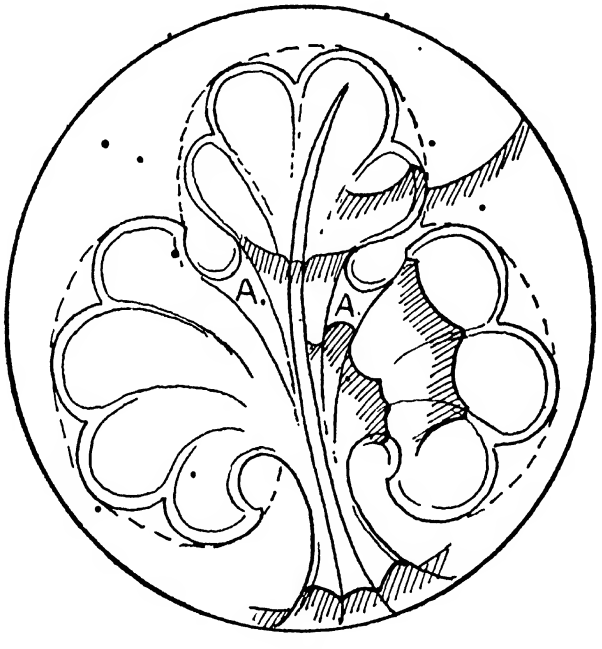


FIG. 8

Be careful, in finishing, to work with the grain, so that the modelling will be perfectly clean and sharp. Next make the midrib of the leaf with two cuts of the parting tool, and then model it with the flat gouge. In order to make perfect radiating cuts from the midrib, when completing the modelling, use the large gouge and commence the cut with one corner of it, gradually turning or rolling it, as the cut lengthens and proceeds towards the margin of the leaf. When working from the margin toward the centre, use the gouge in exactly the same way. If an attempt

is made to use the centre of the gouge only, as in all the previous exercises, it will soon be made manifest that the radiating cuts would continue across the midrib of the leaf and obliterate it. Finish the exercise by cutting, at right angles to the inside of the leaf, the thick outside edges of the pattern, using the inside of the gouge for cutting hollow curves and the outside for round curves.

The Illustrations for the Exercises.—The drawings for the illustrations were made on ordinary brown and white paper, under exactly the same conditions as prevail in elementary and secondary schools. Ordinary charcoal and chalk are the mediums used for the exercises on brown paper, and sepia and a No. 6 siberian hair pencil for the illustrations on white paper. For the pencil drawing of the rosette pattern, H.B. and B.B. penny drawing leads were used. Chalk and charcoal drawings will require to be fixed, when completed. For this purpose a good and perfectly reliable fixitive may be cheaply made from ordinary picture mastic varnish, freely diluted with methylated spirit, blown on to the work with a drawing fixitive spray procurable at any artists' colourman's for 6*d*. A 6*d*. bottle of mastic varnish will make nearly half a pint of fixitive.

Pour some of the varnish into a clean bottle and well thin it with methylated spirit. Test it by spraying on to a sheet of paper on which several lines have been roughly drawn with charcoal and chalk. When the paper is dry, test the solution by trying to rub off the charcoal with the fingers; if it removes, add more varnish, until the solution is strong enough to fix the drawing securely.

Preliminary Drawing Exercises (Plate VIII).—Fig. 1 is a shield with an heraldic device, late fourteenth century. Fig. 2 is a little later. Fig. 3 is the familiar nail-head of the Norman period, eleventh century. Fig. 4, which is obviously a development of the nail-head, is the dog-tooth moulding of the Early English period of Gothic architecture, twelfth century. Figs. 5 and 6 are Jacobean rosette patterns which are characteristic of the period. Fig. 7 represents Gothic boss and leaf patterns of the fourteenth century. This type of ornament should be carefully studied. There are numerous examples in our historical buildings

all over the country; simple expression and execution are the dominant features, together with excellent taste and fitness.

Rubbings.—Copying carving patterns by means of rubbings is a rapid and effective method of obtaining examples of ornament, or reproducing the drawings of one's own patterns from the finished work. The usual method of taking rubbings is to lay a sheet of thin butter-paper over the carving, and then rub with shoemakers' heel ball. A better and clearer method is to have thin typing paper and black carbon paper, and use them in exactly the same way as the heel-ball method.

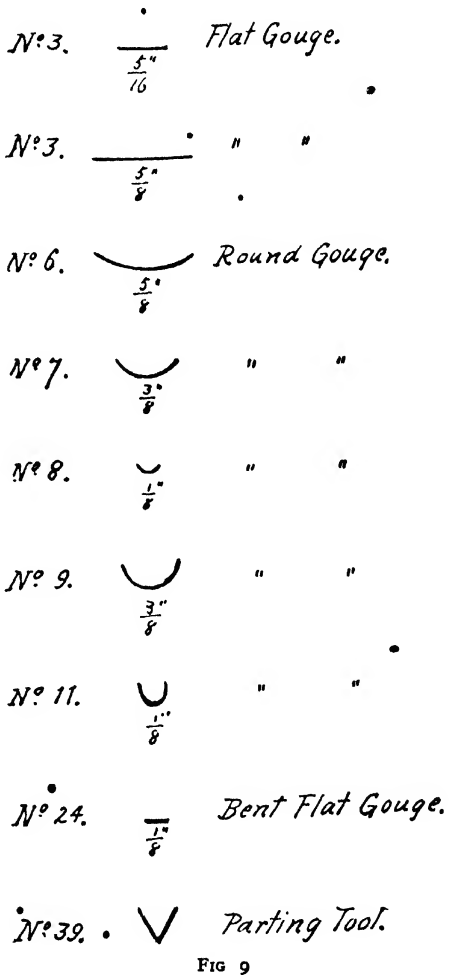


FIG 9

TOOLS AND APPLIANCES

Tools.—The carver's cutting tools consist of chisels and gouges of various sizes and sweeps. Over one hundred gouges of different sizes and sweeps are stocked by most tool-makers of repute. It is not at all necessary for an educational course or for the ordinary student of wood carving to possess a great variety of tools; in fact it is a decided disadvantage, for a multiplicity of tools, except in the hands of a well-trained and highly skilled craftsman, can only result in confusion.

For the beginner a dozen tools at the most is quite sufficient. I recommend nine, but they must be well chosen. After years of experience and experiment I have found those illustrated in Fig. 9 most suitable for all ordinary purposes. They may be obtained from any reliable tool-maker ready handled and sharpened, but I have seldom found the edges keen enough for perfectly clean cutting. Do not buy *tool sets*; you will only have to discard some and supplement the others. Obtain tools having a comfortable handle and not too much metal. The handle and blade of the tool should be about equal in length. The carving tools of the Japanese, who are particularly expert in the art of wood carving, have long handles and short blades; the ordinary English-made gouges have longer blades than handles, which is a decided disadvantage educationally. If tools are ordered with beech handles, ladies' size, you will, or ought to, get the most useful article from every point of view (see Fig. 10).

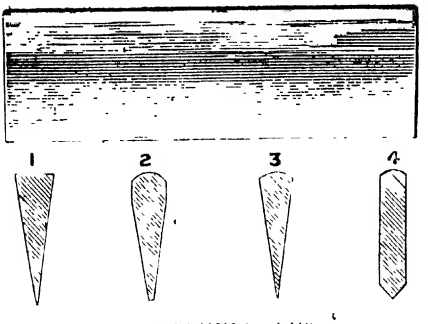
Having procured suitable tools, it is important to see that they are in good working order. They must *cut*, and that easily and clean. The sharp edge as used in the carpenter's shop is decidedly blunt compared with the edge required for carving. This motto should be kept firmly in mind; "You are only wasting valuable time and energy if you try to work with blunt tools." Nine times out of ten when difficulties arise, the tools are at fault. When the simple art of sharpening has been mastered, success is practically assured. The joyous satisfaction unconsciously felt when the timber is cut clean will give fresh inspiration and lead on to fresh conquests. I have never known a student lose heart in his or her work when handling a gouge of razor-like sharpness.

It is necessary to know the right way to set tools. If they have been purchased ready sharpened, test them on a scrap of yellow pine by cutting across the grain. If the cut surface is perfectly smooth and clean, the tools are fit to work with; but should the cut surface appear rough, the edge of the tool is not sharp enough for carving.

The sharpening appliances required in every well-equipped workshop are as follows: grindstone, two oilstones, slips and strops, a small supply of good machine-oil, oil-can, lard, emery

SYCAMORE LEAF (FROM NATURE) STUDENT'S WORK

A. SHARPENING TOOLS ON THE OILSTONE



SHARPENING SLIPS

B—SHARPENING WITH THE SLIP

powder, and cotton waste. The grindstone will only be needed when the cutting edge of the tool becomes irregular, owing to imperfect manipulation on the oilstone, or when the thin edge of the tool breaks and leaves a jagged edge, which is generally the result of carelessness or incompetency, and certainly ought not to occur under careful tuition.

Oilstones.—A careful choice of these is necessary. I would recommend one quick and one slow cutting, the former to reduce the metal rapidly and obtain a flat surface. For this purpose learners will find a carborundum stone, not too coarse, most suitable, and for the latter they cannot do better than obtain an arkansas stone, which will give a keen edge. The slips should also be of arkansas.

Strops.—One or two pieces of soft leather about 10 in. long and 2½ in. wide will be required; or an ordinary shaving strop cut across the centre and the buckle and handle removed will do equally well. In any case the leather will require to be saturated with sweet oil, and the surface smeared with a fairly thick paste made with tallow and emery flour. Don't glue the leather on to a piece of wood—a fairly common practice; the strop will be needed for both sides of the tool. If it is fixed to a flat surface, it is useless for the inside of gouges.

Sharpening.—The question of sharpening and subsequent care of tools needs to be made as clear and complete as possible, as so much depends upon it in order to ensure success and real pleasure in work. First of all, be quite certain that in the process of sharpening there is not a double bevel made on the ground side of the tool, as in the case of a carpenter's chisel or gouge (see Fig. 11). Next endeavour to avoid a round surface as in Fig. 12.

In the first instance the edge will not be keen enough, and in the second, although the edge may be perfectly satisfactory, the pupil will have no adequate command over the tool. This is the section which must be maintained for clean cutting and perfect command (see Fig. 13).

Place the oilstone on your bench or table with the long edges at right angles to the person, and the short edges parallel and near to the front of the bench (see illustration A, Plate XIV). Hold the gouge hollow side upwards comfortably in the right hand, so

FIG. 10

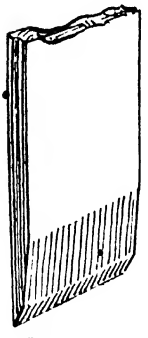


FIG. 11

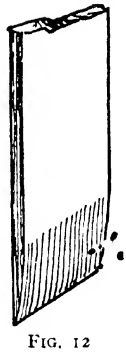


FIG. 12

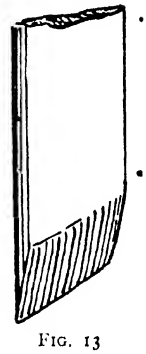


FIG. 13

FIG. 14

FIG. 15

FIG. 16

FIG. 17

that the thumb rests naturally on the flat part nearest the handle; bend the wrist until the tool is parallel to the body; keeping this position, place the ground-surface flat on the oilstone and keep it in firm contact by placing the three first fingers of the left hand on the top of the gouge immediately in front of the right thumb; now move the tool backwards and forwards, at the same time turning it on its axis so that the whole of the curved surface is brought in even contact with the stone (see illustration A, Plate XIV). With a little practice these movements will be made rapidly.

Next take a slip, shaped like the gouge, oil the edge; lay it almost flat on the inside of the tool, and rub it lightly backwards and forwards over the whole surface nearest the cutting edge. When using the slips, hold the gouge in the left hand, with the middle of the blade resting on the edge of the bench and making an angle of about 30° with its centre. Now wipe all the oil off

with cotton waste and hold the edge of the tool towards the light. Should a little streak of bright light be seen, it is not sharp enough, and requires more rubbing on the stone and with the slip. Finally, strop it on the leather, by holding the tool firmly in the right hand, and, with the forefinger on the blade pressing firmly on the leather, drawing it towards the person several times. Then strop the inside of the tool, away from the person, with the leather curved to fit the gouge, and used like a slip.

Always test the tool on a piece of yellow pine, as already explained. Take care to keep the cutting edge of the tool square, (Fig. 14), not curved (Fig. 15), hollow (Fig. 16), or irregular (Fig. 17). Keep the strop in constant use. You would not think of using a razor more than once without stropping—exercise the same care with your carving tools and thus save valuable time.

BOOKS FOR REFERENCE

ELEANOR ROWE: *Practical Wood Carving* (B. T. Batsford). DAVID DENNING: *Wood Carving for Amateurs* (L. Upcott Gill). GEORGE JACK: *Wood Carving and Design* (John Hogg). PAUL HASLUCK: *Wood Carving* (Cassell).

LVII. PAPER AND CARDBOARD MODELLING FOR SENIORS

By JAMES BOORMAN.

Leipsic, Nāās, and City and Guilds Diplomas for Manual Training in Metal, Wood, Cardboard, etc.; Lecturer to, and Instructor of, Teachers' Training Classes in London, Glamorgan Summer School, etc.; Lecturer on Principles of Handwork in Schools, and Technical Instructor to Teachers in Training at L.C.C. Shoreditch Technical Institute.

The Special Value of Advanced Cardboard Work.—Cardboard work as a subject of instruction in senior schools has seldom received that meed of attention which it undoubtedly deserves. This has doubtless been due to the fact that but few teachers have been, themselves, expert in the work, and consequently few have appreciated the scope that it offers for achieving those educational results at which manual training in general aims, or the valuable preliminary training it affords for other work. It cannot compare favourably with woodwork in regard to the number and variety of tools employed, or the varied muscular discipline and training involved in the tool operations; but when, for any reason, woodwork cannot be introduced, cardwork probably affords the best substitute. Moreover, the short time required for the execution of many of the various constructional devices and joints; the introduction of line and colour in the design and decoration of the objects; and the possibility of taking the work home and carrying it on there without special apparatus, make the work in these respects a better subject of instruction than woodwork. Again, no such physical exertion is required as to preclude girls of even delicate physique from undertaking it. Finally, the tools are few and cheap, and the materials often to be had (in great part) for little or nothing.

Some Important Operations.—In dealing with constructive work in paper and card, as arranged for children over nine years

of age, it is well, perhaps, to consider first other operations that are involved, in addition to those taken in previous articles dealing with the work for younger children; since it should be the aim now to produce a higher standard of excellence and exactness than is necessary or advisable in their case. The operations are not many, and are not difficult to accomplish, so that such a degree of dexterity may soon be acquired as will leave the mind free to attend to the constructive details as distinct from the actual operations. Moreover, when these operations are properly carried out, a great difference in the result is achieved, while at the same time the correct handling of the tools materially increases the speed and efficiency of the worker in this, just as in any other subject.

Again, the mental processes involved in forming a concept of a more or less intricate piece of work as it will appear in its completed form, in picturing its various parts and their exact relation to the whole, and then devising the simplest and most expeditious means by which these parts may be executed and combined to produce the finished article, are of a higher order than the mental processes involved in acquiring the correct handling of simple tools. Hence, when this correct handling has become habitual, energy may be diverted almost entirely to the consideration of finished form and constructive detail, with consequent development of the higher faculties of mind. But the habit of correct handling of tools is essential to safety and to progress.

(1) *Pasting Large Surfaces* (Plate XV).—In regard to pasting large surfaces, such as those of covering papers or cloths, a few hints may prevent some mishaps and disappointments. A few experiments will show that the expansion of the material is in proportion to its size, and to the amount of moisture in the adhesive used; that raised or moulded papers will not expand equally in both directions; and that the softer and more absorbent the paper, the more it will stretch. In small work this expansion may be neglected, but allowance must be made when dealing with any material over a few inches in length.

The paste used for papers should generally be much thinner than that used for cloths; but care must be taken not to use

too much, since in some cases it will soak through the papers and spoil the colours. Ordinary paste is not suitable for use with bookbinders' cloth, as it quickly penetrates and spoils the surface, at the same time causing so much irregular expansion and loosening of the texture as to render the material unmanageable by any but experienced hands. If ordinary paste is used, it must be as thick as soft butter, and the cloth should be got into position on the card as quickly as possible. The card will then absorb a large proportion of the moisture, and better adhesion will take place. The paste known as vegetable glue answers well, and a mixture of glue and paste, as used by bookbinders, is effectual. Ordinary bookbinders' paste is made from rye flour, and is very strongly adhesive. Glue alone is apt to crack, especially if used at all thickly, or where cloth acts as a hinge.

In pasting paper or cloth, the face side should be laid downwards on a sheet of clean newspaper rather larger than the material being pasted. The paper should be held in position with the fingers of the left hand, spread as widely as convenient, near the left-hand side. Then with a moderate amount of paste on the brush, and beginning near the fingers, the stroke should be taken always in a direction away from them, but carried right over the edge of the paper. The brush must not be used in the opposite direction, but should be lifted from the paper, and the strokes repeated in the same direction, till the surface has been quite covered, except at the end where the fingers are holding it. The fingers should now be raised, and put on the paper near the other end, and the brush used again, still stroking away from the place held. The effect of a stroke in the opposite direction will be to cause the paper to ruck up. Some paste will inevitably get on the newspaper, where the covering paper is laid, and when the paper returns to its position, this paste will be transferred to the front of it.

(2) *Applying Covering Papers and Cloths* (Plate XV).—When applying the paper, it should be lifted, and held in the two hands, as shown, a long edge being between the two hands, the first fingers on the top near the corners to direct them, and the thumbs opposing the second fingers, in order to hold the paper and lift the back edges, as may be convenient. When this long

PASTING A LARGE SHEET OF PAPER

PLACING A BOX TO BE COVERED ON THE COVERING PAPER

APPLYING COVERING PAPER

PASTING A FLANGE

BENDING OVER EDGE OF COVERING PAPER BY MEANS OF NEWSPAPER

SPLITTING A FLANGE

RUBBING DOWN THROUGH NEWSPAPER

ROLLING A CYLINDER

edge is correctly placed, the hands may be used to lay the rest of the paper with a backward movement, keeping the paper moderately tight between them. Watch the remaining edges for position, and gently stroke the paper down from a middle position towards the outside, and if any margin shows too widely, a little additional gentle rubbing in that direction may improve matters. If the pattern is much raised, little or no rubbing can be done, but after placing the paper in position, it must be gently dabbed down, and a light weight placed upon it, till the paste has begun to set.

There are some cases, when the paper is to be brought over the edge of the card to be covered, in which advantage is gained by laying the card in position on the covering paper after pasting the latter. Holding the card down, the edge of the piece of newspaper on which the covering paper lies may be folded over on to the card, bringing the covering paper with it (Plate XVI). Then holding the newspaper against the edge, the covering paper may be rubbed down through the newspaper. This method is specially valuable when using fragile and delicate papers, as a good result is obtained without risk of tearing the paper. In fact it is a good general rule always to put a piece of clean newspaper over the cover when rubbing down with the fingers. It will prevent undue stretching, and also the rubbing of the colours from the surface.

Another general rule to remember is that when two pieces of material are to be joined, it is always the thinner of the two that is to be pasted or glued. If the thicker material is pasted, it will expand, and its subsequent drying and contraction will cause the thinner covering material to lie unevenly. On the other hand, if the thinner material is pasted, it is then applied in its expanded condition, to the thicker material. The greater rigidity of the latter enables it to resist the tendency to contraction of the thinner material which becomes tightly stretched, thus presenting a perfectly even surface.

(3) *Bevelling and Making Other Simple Mouldings* (Plate XVII). —When thick card is used for the base or top of a box, or for similar purposes, its appearance is often much improved by the edge being bevelled, or rounded. In making a bevel on the card, lines should be drawn on it to define the limits of the slope on both the top and

the edge. It should then be pressed flat on the cutting board, with the edge of the card to be worked exactly coinciding with the edge of the board. This is for the purpose of supporting the edge of the card, and to prevent it from bending out of position, when, in cutting, the pressure from the knife is brought to bear upon it. If the cutting slab is thin—as, for instance, when it consists of a piece of zinc plate—the slab should be brought to the edge of the table or bench, or raised from the table top by placing a support under it, in order to give room for the fingers, and for the handle of the knife, during the operation, as shown in Plate XVII.

The condition of the knife edge is very important in this operation, so that it is necessary to see before commencing that it is quite keen, and that the cutting angle of the edge is small. If the bevels of the knife are not fairly flat, it will be found very difficult to make straight cuts. When the actual cutting is done, the cuts should be made with the knife in the right hand, and in the direction away from the operator, while holding the card firmly on the board with the left hand. The handle of the knife should be below the card, not over the board, and the point of the knife should be as much as possible in front of the handle. This gives a long sloping cut, the most effectual in nearly every class of cutting.

The reasons for this position are that, in the first place, the cutting away from the operator is best from the point of view of safety. Then, the hand being below the card, the person cutting is able all the time to see easily what the knife is doing, and the inclined position of the knife reduces the cutting angle of the blade, thus ensuring a cleaner and more effectual cut. This is often called a shearing cut, but the use of this term has no connection with a shear, as understood in the study of stresses and strains, and the real effect of this position is exactly the same as if the blade had been sharpened to a very thin angle, as it might be on a razor blade, but without the consequent loss of stiffness and strength. With practice the bevels may be finished with the knife cut, but the inexperienced worker will probably find that the surface is not as flat as he wishes.

The surface may be improved by rubbing with a piece of glass paper held flat on a piece of wood. In using this glass-paper

block, very different results may be obtained with the same grade or piece of glass paper. The card will need to be held in the same position on the board as in cutting the bevel with the knife. Then if the stroke with the block is made downwards in relation to the slope of the bevel, the minimum of material will be removed, and the smoothest effect produced; while if the stroke is made upwards, the maximum amount will be removed, and quite large pieces will often come off in flakes. This is due to the laminated structure of the card, as the result of which the working corresponds somewhat to working with or against the grain on a piece of wood. A study of the difference in the effect produced, by difference in the direction of the strokes, between the two results will show which will best produce the effect required in any particular instance.

If a convex moulding is to be produced, a series of cuts tangential to the curve of the moulding will be made, and a piece of glass paper may be modelled to the shape in the fingers, and rubbed along the edge, to give it a finish. A concave moulding is usually built up of several thicknesses of card cut to form steps, the angles of the recesses of which give the form desired. A piece of wood is shaped so that, with the addition of a piece of glass paper, the reverse of the form is obtained. This is then rubbed along the channels to remove the edges, and to bring the material down to the required shape.

(4) *Making a Corner, as for a Box.*—Scoring, or half cutting the material, and bending it to the form required, has already been explained. This is a suitable method for making a corner, when the material is stout carton or thin card; but half the strength is lost at the angle, where most strength is needed, and, at any rate, at least one corner of every box will have to be joined by some other method.

The most common method of making such a join is by pasting a piece of cloth along the outside of the angle, lapping half its width on to each piece to be joined. In its simplest form this strip of cloth may be half an inch wide, and of a length exactly equal to the length of the edges to be joined, thus finishing flush at the top and the bottom of the box, without any turning over the former or under the latter. If the bottom is to be strengthened

at the corner, the cloth will be cut off at half its own width longer than before, and slit along its middle line for this distance. Having pasted or glued the piece of cloth, it will be applied to the angle, beginning at the top. One-half of the piece extending below the bottom will be folded underneath the bottom, and will thus cover a small square at the angle. The remaining piece should be cut with scissors to an angle of forty-five degrees, that is, along the diagonal passing through the angle of the box, and folded down over the former piece. This method will then show a mitre line from the angle, and will improve the appearance without loss of strength.

Care must be taken that the cloth has the paste well rubbed into contact with it, though it must not be stretched out of shape. When put on the card, it must again have careful pressing and rubbing to ensure contact, or the join will not be a strong one. The corner of a rectangular piece of wood placed inside the box at the angle will offer a good resistance, and pressure may be exerted without pushing the box out of shape.

In some cases a little additional strength at the expense of some clumsiness will be gained by making the cloth strip long enough to turn over at the top edge, as well as under the bottom. The cloth will need to be cut down the middle before folding, because, the inside of the box being smaller than the outside, there will be surplus material to dispose of in the corner. By slitting the cloth, this can be disposed of by a neat lap. To avoid clumsiness, the cloth may be replaced by tracing linen, which, being very thin, is hardly perceptible through even a thin covering paper.

The connection of the bottom with the sides of a box may also require strengthening by a strip of cloth put on in the same way, but usually the covering paper will be taken over the edge, and is sufficiently strong to carry the weight generally put inside small cardboard boxes.

The cloth used may be of any colour, and may form part of the ornament by showing a fine line of colour down the angle, when the box is covered with paper, or, as in those cases when the card is not to be covered, showing its entire width. When using thick card, it is necessary that the joints should be made

by cutting the edges quite square and true, and butting and gluing them together, afterwards binding with cloth. More exact work can be done, and more perfect corners formed, than by half cutting and binding.

In a few other cases, when working with medium or thick card, it may be advisable to make the joints by cutting a V groove on the side of the card towards which the bend is to be made. If this cut is accurately made, and a little glue or paste is brushed into the groove just before finally putting into position, it makes a strong joint. The outside appearance is excellent, although the corner is slightly rounded, and has not so sharp an angle as the butt joint.

(5) *Making a Cylinder* (Plate XVI).—The procedure in making a cylinder will alter with the size and the proportions of the cylinder to be made. If of relatively small diameter compared to its length, it is usual to make it on some other cylinder, used as a mould upon which the material may be rolled. The material used must be sufficiently flexible to bend easily to the curve required, without showing cracks. Card will be more liable to crack in proportion to its dryness, and material otherwise quite suitable may be spoiled for the purpose by storing it near a radiator, or on the top of a cupboard near the ceiling of a room lighted by gas.

For small cylinders, brown paper or manilla paper answers well, and, speaking generally, if the cylinder is to be made by rolling on a mould, the thickness of the material should be such that it passes at least twice round the object, without making the body too thick. As it is not often that a cylinder of an exact diameter is required for class work, two or three different sizes will usually be found sufficient, and the cylindrical objects to be made can be adapted to suit the size of available moulds.

Having, then, to make a cylinder, and possessing a suitable mould of wood or other material, the first step is to cover the mould with at least two thicknesses of dry newspaper. This is to form a sleeve, and prevent the possibility of the paste of the model reaching the mould and permanently sticking the two together. The next step will be to determine the necessary length of material. Three and one-seventh times the mean diameter of the body, multiplied by the number of revolutions decided

upon, with the addition of any required lap, will give a sufficiently accurate result for the purpose. If the material is brown paper, no lap need be allowed. If, on the other hand, the material is thicker than this, the part forming the lap must be thinned out to a fine edge for a distance equal to the width of the lap. One inch is usually a sufficient amount to allow for a lap.

If the cylinder is to be lined, it is convenient to paste the lining on to a sufficient length of the body material to go round once and a little over, before the rolling is done. The lining should be allowed to project half an inch or so beyond the edge of the body material, so as to make the joint of the paper come at a different place from the edge of the card. It must be allowed to get quite dry before any rolling is attempted, or the inside will not be smooth, but will develop unsightly ridges.

It will be well, if the material is thicker than stout brown paper, to give it a preliminary rolling before pasting, so that it may the more readily assume the correct shape afterwards. Then, first pasting the back of the material for a distance of about 2 in. or so from the inside end, turn it over, and begin rolling it on the mould by pressing firmly, and rolling steadily on the table to keep the material tight. This is illustrated in Plate XVI. When the limit of the pasted area is reached, while still holding the roll firmly with the left hand, paste the remainder of what will be now the upper surface, and continue rolling, being careful that the edge receives its proper amount of paste. When all the card is rolled, two or three thicknesses of newspaper may be rolled round it without paste, except just a touch at the end to hold it down. This will act as a bandage, and will keep the otherwise free end of the card from unrolling, as it will tend to do if left unfastened.

Then leave the whole to dry. This will take some three or four hours at least. When quite dry, remove the outer layers of newspaper, and examine the joint. If not quite smooth, a little rubbing with glass paper will improve it. Next mark and cut the ends to the proper length for the finished cylinder, while it is still on the roll, and then firmly draw the cylinder off the mould with a twisting motion.

(6) *Grooving and Halving.*—When putting partitions into card boxes, the fixing into position is often done by sticking a piece

of linen or even of paper along the angle made with the side or bottom, and for much work this is sufficiently strong. A better way, however, is to cut a shallow groove of rectangular section in much the same manner as in a wood structure of the same kind, and allow the partition piece to enter the groove. Two cuts are made of the required depth and at a distance apart equal to the thickness of the card, and the piece between the cuts is carefully removed. The laminated character of the card will make this an easy matter. The edge of the partition piece and the groove should always be dressed with adhesive to make a solid joint. Another way is to cut a V groove, and shape the edge of the partition piece to fit it. This is more difficult, and seems to have little advantage over the rectangular method.

(7) *Making a Hinge.*—Another piece of work of fairly frequent occurrence will be the making of a hinge. This will vary from a simple piece of cloth pasted on the two parts to be hinged together, as in a simple card photo frame with a back (see Fig. 5), to the more elaborate joints used on heavy boxes (see Fig. 20). Some careful thought as to what is really necessary in a hinge, and as to what are its causes of failure in regard to either strength or appearance, will be helpful. It must be remembered that bending necessarily involves an alteration of length on one or both sides of the hinge. The extent of this alteration will depend upon the thickness of the material forming the hinge. Therefore one consideration must be to reduce this thickness as much as possible.

No superfluous paper, paste, or cloth should be allowed where the actual bending is to occur, and if the usual two thicknesses of cloth are there, they must be pressed quite close to one another, and actually be stuck together, or cracking is almost certain to be the result. Also the material for sticking must be of a tough rather than of a hard nature. Ordinary glue does not answer so well as some of the tougher pastes. A mixture of glue and flour paste answers better than glue alone. Vegetable glue is very good, but costly.

In most cases the hinge will be of the continuous type—that is, it will extend the whole length of the edges which come together. Another point to consider, therefore, will be the distribution of strain. This is by no means equal at all points along the joint,

as may be deduced from the fact that the end will nearly always give way first. Therefore if the strength is to be proportioned to the work, the ends must be made stronger than the parts at or near the middle. Also, when a piece of cloth has been cut, the selvedge is lost, and tearing is much more easy than it otherwise would be. It is therefore usual to fold over the ends for a distance of half an inch or more, in order to give greater strength there.

Other considerations will be the width of the space between the two cards, or edges, to be joined, and the amount of swing necessary for the purpose of the joint. If the moving part is to swing on both sides of the plane of the fixed part, as, for instance, in a clothes-horse, more room must be allowed, especially if it is to fold flat on both sides, and the actual position where bending occurs will profitably be in the middle of the thickness of the card. If the moving part is to swing on one side only of the plane of the fixed part, the joint may be flat on that side towards which the moving part is to revolve. Thus the cloth will lie quite flat on that side, while on the other it will have to follow the indent due to the space between the cards, in order that the two pieces of cloth may be in contact where the bending is to occur.

If the pieces are not in the same plane when at rest, but at right angles to one another, as in some box lids, care must be taken that the inner cloth adheres closely to the different surfaces presented by the faces and edges of the cards, and also to the outer cloth at the hinging line.

(8) *Binding with Cloth.*—Many edges of trays and boxes will need to be bound with cloth for purposes of strength and appearance. The resistance to wear of the cloth is much greater than that of the paper or card, so that any parts likely to be subjected to hard wear, such as the corners of books or covers, may profitably be bound with cloth. The first thing to consider in this matter is the width of cloth advisable. Half an inch is usually considered sufficient, but more strength is obtained, and there is greater ease in manipulation, if it is somewhat wider. When it is narrow, it has such a tendency to curl away from the damped side that it is often very troublesome, in spite of a previous creasing and folding. When mouldings are to be covered, the

width will be the length of the developed outline of the section, with the addition of not less than a quarter of an inch for each of the adjoining surfaces.

In the actual process of covering a moulding, after the piece of cloth is pasted, it is generally best to lay the edge of the cloth to a line on the top surface, drawn so as to allow the necessary flat area for holding purposes, or for appearance. Then, placing the steel rule on this part of the cloth, it should be held firmly in position with one hand, while, with the other, the bone is used to work the cloth into the form of the moulding, treating the recesses, if such exist, downwards from the top edge.

In dealing with the intersection of the pieces at the corners, it is advisable to let the cloth first put on run slightly by the actual corner, and to return it along the adjacent moulding. In the case of the first piece put on, this should be done at both ends. In the next and succeeding pieces, one end only will be treated in this way, while the other will be cut exactly to the intersection, giving the true mitre line. The last piece will have the mitre line cut true at each end. This method ensures the complete covering of the angle with cloth, and the return piece, if only about an eighth of an inch, can be easily pressed into the card, so that no edge will show through the second piece of cloth.

Some very fine and delicate yet strong mouldings may be made in this way, and if some gold or silver leaf be applied in fine lines, or on the small squares of the moulding, showing the grain of the cloth through it, still greater beauty may be obtained. It is only necessary to paint the line on the cloth with gold size, leaving it till "tacky," and then cut and lay on the leaf, brushing it down with a camel-hair brush.

In binding edges which are not in a straight line, the cloth may with advantage be shaped before pasting. If the curve is only a slight one, this can be done without tearing, using a piece of cloth cut straight from the piece; but if the curve is considerable, it will be necessary to cut the material "on the cross." This means that it is cut at an angle of about forty-five degrees with the edge of the roll, instead of parallel to it. The effect of this is that all the threads of the cloth are cut into short lengths, and consequently the piece may be distorted to almost any extent

without tearing, if care is used. More skill is needed to manage it, as, once stretched, it will not again contract, and in all cases there should be a minimum of stretching.

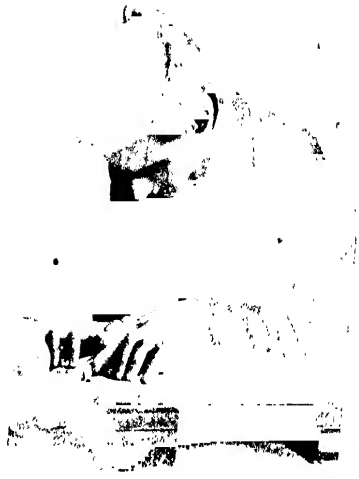
In some cases it may be advisable to cut a number of small darts from the edge of the cloth, instead of stretching it. When this is done, care must be taken that only so much is cut away as is necessary to prevent undue lapping, and on no account should the card show between the darts, when the cloth is laid.

Having now dealt with the more frequent operations, the remaining ones will be considered as the construction of particular objects calls for their employment. It must not be understood, however, that the previously described operations would be taught apart from their definite use in connection with some object. They have only been treated in the above manner for the benefit of teachers, who may thus be in a better position to deal with children when taking the work.

The Making of Models.—*Foolscap Envelope* (Fig. 1).—The method of procedure to be followed in dealing with the construction of an object by a class of children may be illustrated by taking the case of an ordinary foolscap envelope. A piece of foolscap paper should be folded first in the usual way for enclosing in an envelope. The children should then measure its dimensions. They should be questioned, and should be led to estimate what extra size should be allowed in the envelope, in order that the paper may go in easily, and to state what difference would need to be made, if more papers were to be enclosed. The method of folding will be one familiar from earlier work, but now the reasons for the method should be discussed, alternative methods considered, and the most suitable for the material to be used should be adopted.

This will bring prominently forward the consideration of available material, a very important point in many lessons. Having decided on the material to be used, which may be cartridge, manilla, or even brown paper, the children should sketch out the development, reasoning out each step, and writing down on the sketch all the dimensions. The question of the size of the flanges will come up for decision, and this must be governed by consideration of the strength of the adhesive to be used, the

BEVELLING WITH KNIFE

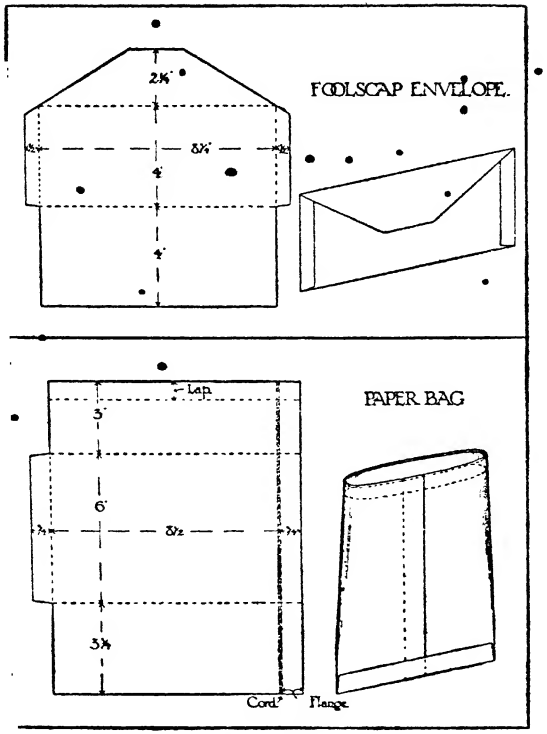


RUBBING DOWN WITH GLASS PAPER

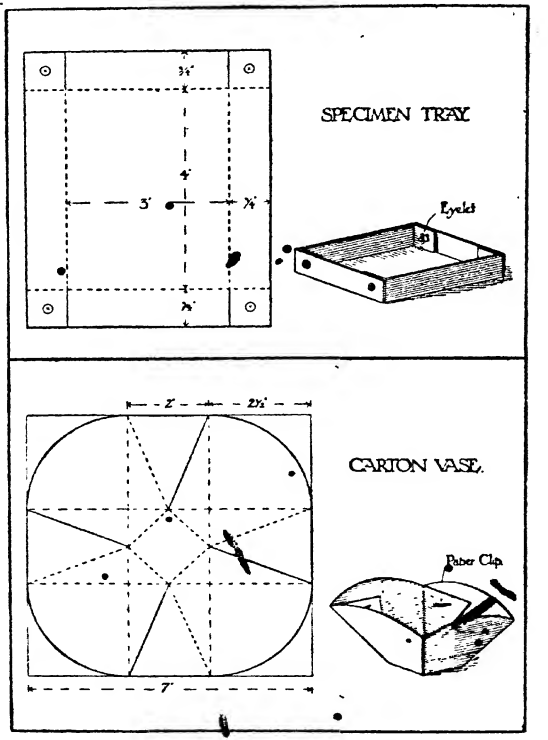
MODELLING CURVED SIDE OF A VASE WITH BONE FOLDER

JOINING CURVED SIDES OF VASE

REPRESENTATIVE GROUPS OF CARD MODELS



FIGS. 1 AND 2



FIGS. 3 AND 4

stiffness of the material, and the inconvenience of holding down a flange for a long time—a narrow flange requiring to be held in place longer than a wide one. A nice little question on leverage is involved in this.

Having then made all necessary calculations and decided what to do, the drawing may be made on the paper. The use of a set square and rule will be essential, if this drawing is to be well done. The cutting will now be done with a knife and straight edge, instead of scissors, the latter only coming into use for curved outlines. The creasing along the folding lines will be done with a bone folder, and the whole will be folded into place, and tested to the degree of accuracy required.

If this is found satisfactory, the paper will be laid down for pasting, and the flanges pasted, while the rest of the envelope is protected by waste paper, as previously described. The flanges may then be again folded into place. When all is done, and any superfluous paste carefully removed, the envelope may be laid under the cutting board for a few minutes, in order to hold the flanges down. It may even be left till dry, with advantage to its flatness.

Briefly, the stages in the lesson will be, first, the announcement of the aim—that is, to make the required envelope; then an analysis of the aim, with determination of details of size, shape, and development. Then will come discussion of processes, which will be found to include measuring, marking off, cutting out, creasing, folding, flanging, and pasting. Next will follow the acquisition of the knowledge of any necessary operations not yet learnt, and after this the actual making, involving the application of the knowledge gained to the production of the particular object contemplated. Finally, the knowledge and additional skill acquired may be generalised—that is, its sphere of application may be widened, the children, with the teacher's help, being led to suggest other articles in the production of which it may be utilised.

Paper Bag (Fig. 2).—The paper bag given next introduces a method of strengthening the weak place in such articles. It is usually at the top edge that tearing begins. Children should be asked to suggest how this edge may be made stronger, and they may be led to see the advantage of inserting a cord. The question

as to where the joins of the cord should come may be discussed. The need also of well pasting the ends of the cord when put as shown in the drawing, and the advantage, in some cases, of unravelling a little at each end, to make it flatter where the two ends come together, may be reasoned out. The arrangement of the folds so as to bring the visible line of the join in the centre of the bag, for the sake of appearance, and the width of the flaps likely to give greatest strength, will again come up for consideration.

The folding line for the top should be well creased, and the doubling piece bent right over before pasting. This should then be laid out flat again, and pasted, the cord laid in the crease, the top folded over, enclosing the cord, and the whole rubbed flat. The rest of the folding may then be completed.

Carton Tray (Fig. 3).—The next model illustrated introduces the use of carton, a material somewhat thicker and stronger than paper. The creasing will require to be deeper, and more thorough, than in the case of paper, if the folds are to bend well without cracking. The creases should be made right along the whole length of the developed material, and the cuts necessary for the separation of the flanges should be made in the lines thus marked, but only, of course, for the necessary length from the ends. The flanges at the corners may be fastened in various ways. The use of eyelets is suggested.

The holes are easily made by means of one of the several types of punch pliers on the market, and the tool for fixing the eyelets is just as easily managed. The eyelets are very cheap; they can be had, of excellent quality, for 1*s.* 3*d.* a thousand, and will be found very useful in the work, as they provide a clean and expeditious method of fastening. The connection may be made rigid by tight squeezing, or a loose revolving pivot may be made by leaving the eyelet only partially opened. The eyelets will be found to materially strengthen holes in card for suspending, for lacing, or for tying parts together. They may be obtained in several colours, and of different sizes.

Carton Vase (Fig. 4).—This model introduces a new form of development, and cutting to definite curved lines. The setting out may be made more or less difficult, so as to suit the mental capabilities of the pupils, by varying the data given. It is neces-

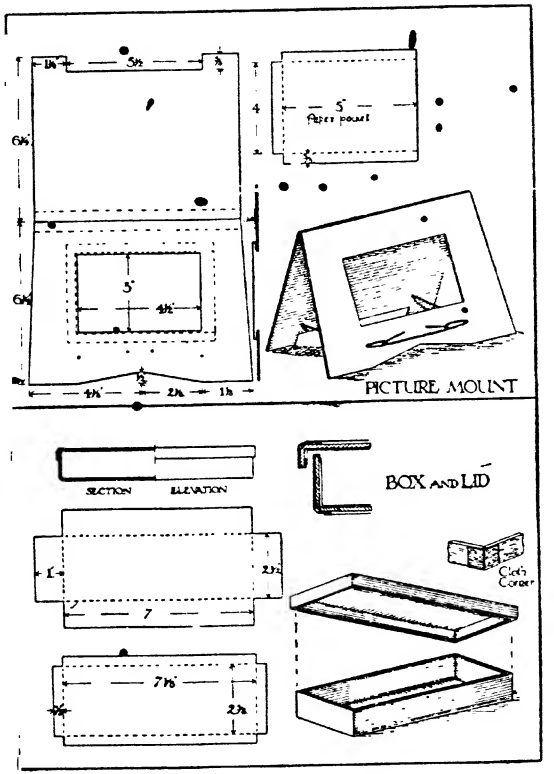
sary to know the size of the square base, which must be placed with its sides parallel to the diagonals of the outer square. The width of the sides at the top, or the height of the sides, will have to be decided upon, and this will then give the position of the corners on the sides of the outer square. The curves may be struck with compasses from a convenient centre, or may be other than circular, but should be all alike and symmetrical.

Picture Mount (Fig. 5).—This model is very attractive, and is one of a type that has an extensive range of usefulness. It introduces mount cutting, in which knife cuts must be stopped at a definite point at both ends. This requires care to make a clean cut finish at the angles, and, if desired, the difficulty can be increased by making bevel cuts. This gives an improved appearance, by showing a fine margin round the picture.

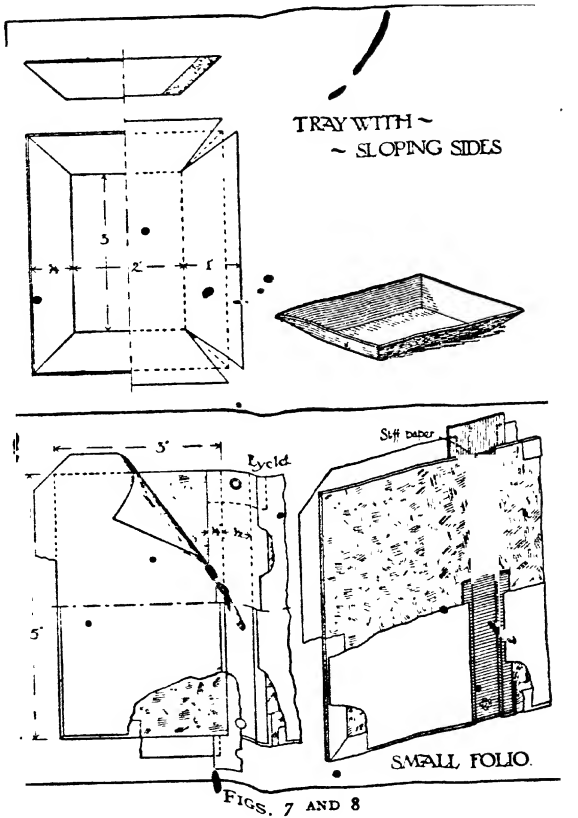
The shaping of the outline for the purposes of ornament gives opportunity for expression of a child's ideas of beauty in outline, and for the teacher to train those ideas in right directions. He will lay stress on the importance, as principles governing design, of making ornament subservient to use, and of recognising the possibilities and limitations of the material.

The material used may be white pulpboard, brown card, or tinted carton. The hinge may be simply a half-cut in the card, but it is improved by adding a strip of cloth at the back, to strengthen it. This must be put on, when the card is lying flat, and should not be bent double till the paste is quite dry, or it will not keep a good shape. The frame may be decorated with brush drawings, or with silhouettes of geometrical, floral, or animal forms, cut out and applied. The cord or ribbon used should be bright coloured and tied with ornamental bows. This will give additional exercise for little fingers. The paper pocket to be applied to the back of the front part, to take the picture, needs consideration. The flanges need careful pasting, and a piece of card or thick paper, cut to the size of the picture, and used as a mould on which to fold the flanges, is useful. This may be left in while the flanges are being pasted, to prevent superfluous paste reaching wrong places. Picture postcards provide good objects for mounting.

Box and Lid (Fig. 6).—The making of a box, bound with cloth



FIGS. 5 AND 6

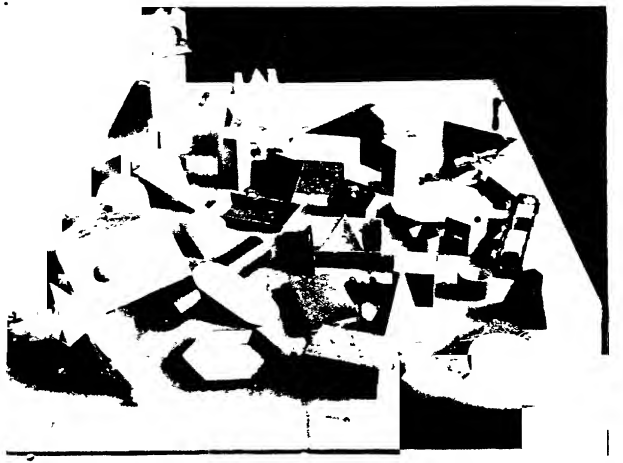


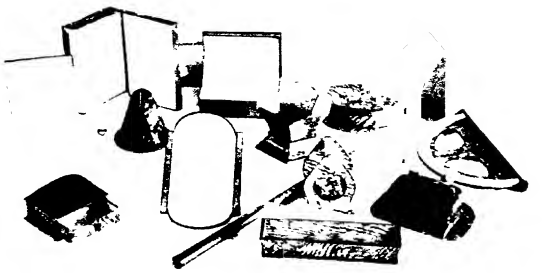
FIGS. 7 AND 8

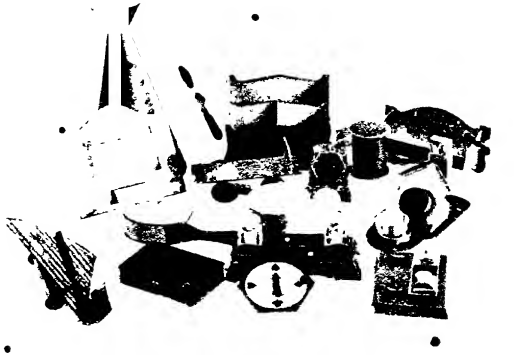
at the angles, and covered with paper, is illustrated in this drawing. The material may be wood-pulp board of medium thickness. The size of the box will, of course, be varied to suit the purpose for which it is made. The sizes given will be found to be about the most suitable for early attempts. The box itself should be made first, and then, allowance being made for fitting, the size of the lid measured from it. It will be found an advantage to make a loose fit in early work, and to make closer-fitting lids as the skill of the children increases. For early attempts, coloured margins of cloth should not be attempted, but the paper should form a complete cover. What is known as white union, or box cloth, should be used for the joints. Having fastened the box together, the covering paper should be cut out next. It should be of a length sufficient to go all round the box, with the addition of about half an inch for lap. The width should allow for the height of the box side, with three-eighths of an inch to fold under the bottom, and the same amount to fold over the top edge. Pencil lines should be made on the back of the paper to define these margins.

Having pasted the paper, the box may be applied to the paper, as the latter lies on the bench (Plate XV). First let one corner of the box exactly coincide with the end of the paper. Next roll the box in cartwheel fashion along the strip, bringing the paper adhering to it, and keeping it in position for securing the correct margin. When the last side has been attached, lift up the paper at the corner where first applied, carry the lapping piece round the corner and then bring the first end again into place over it. Thus the join of the paper on the outside will be at the angle. Now, having slit the bottom corners of the paper, fold down the two long pieces, rubbing them into place with the thumb and fingers. Then cut the other pieces so as to show the mitre lines at the angles and fold them down. The box may now be stood on the table right way up, and the paper may be cut at the top corners and folded over the top edge. The bone folder will be useful for working the corners out to a square angle. The bottom may next be covered with brown or other hard-wearing paper, leaving one-eighth of an inch margin.

In lining the box, the bottom should be done first. Then a







REPRESENTATIVE GROUPS OF CARD MODELS

PLATE XIX

strip of lining paper should be cut the full length of the four sides, with an addition for the lap. The width should be equal to the exact height to which the paper must reach. It will thus be equal to the interior height less the width of margin to be shown. One-sixteenth to one-eighth of an inch will do for this. The more expert the worker, the finer the margin may be. Having cut the paper, paste it, and fold it backwards and forwards into folds about 1 in. long. This method keeps the pasted sides of the folds together, and the clean sides together. Having seen that there are no lumps of paste on the edges, place the pasted strip inside the box, standing it on its edge. Now start applying the lining, beginning with the end in one corner; work round carefully, especially in the angles, unfolding the paper as the work proceeds. When near the end, release the end first applied, place the piece for the lap underneath it, and replace the end that has been raised. Thus, again, the join comes right in the angle. The lid may be worked in the same manner, or the covering paper may be all in one piece, of similar form to the developed card. If the lid has at all a close fit, it should not be put on the box till both are quite dry.

Tray with Sloping Sides (Fig. 7).—This is a favourite model giving an opportunity for teaching several geometrical principles, and providing good examples for practice in mensuration. The nature of the problem of development will vary according to the data given. The covering and lining will need a different method from that followed in the preceding model, as each side must be dealt with separately. Lapping at the angles, and the neatness of finish on the top and bottom of the corners, will demand more skill and ingenuity for complete success.

Small Folio Cover (Fig. 8).—This folio cover is a most useful model, and one which every child should make in some form or other. It may be used as a note-book cover, or as a cover for loose leaves. It affords exercises in covering, binding, and hinging. It should be made a quarter of an inch longer and wider than the notes to be protected. The distance at the back between the card sides should be at least a quarter of an inch more than the thickness of the book. The first process will be to cut out the cards to the size required. Next, the cloth for making the back should be

cut, the length in this case being greater than that of the cards by the amount to be turned over at the two ends. The width will be the amount of space to be allowed between the cards, added to the amount required to lap on to the cards at each side. The latter will be governed by considerations of strength and appearance. Half an inch is usually enough for strength, and the amount to be allowed for appearance is a matter of taste.

The material used for the back is sometimes allowed to show for as much as a third of the width of the card. In other cases only a fine line is shown. The cloth for the inside of the back will be one-eighth of an inch shorter than the length of the cards, and the question of strength alone will be considered in deciding on the amount of lap required, as, in practically every case, the lining paper will leave only a narrow margin showing. A strip of stiff paper—brown or cartridge—will be pasted between the two pieces of cloth, and will improve the appearance of the back, by preventing unevenness and any bending at improper places. It will require to be of exactly the same length as the card, and one-eighth of an inch less in width than the space between them. The sizes and shapes of the covering and lining papers can be seen in the drawing.

Having all the material cut out, paste the cloth back, then put the brown-paper strip in the central position, and next place the cards in their respective places, rubbing down gently. Then fold over the top and bottom pieces of the cloth back, so as to double the ends. Next paste, and apply the cloth lining for the back, leaving one-sixteenth of an inch margin at the top and bottom. Rub well together, especially in between the cards and the edges of the brown paper, in order to ensure close contact there. Then, having pasted the outside papers, lift up the covers and lay them face downwards on clean newspaper. Take up one piece of the covering paper and apply it in the correct position, rubbing gently into contact with the card. Now repeat with the second piece. Again turn the covers right over, and, if it has not been already done, cut pieces off the corners as shown. Then fold over the laps of the paper to the inside, as shown in the photograph (Plate XVI), using the newspaper to lift them up and to protect them from injury, while rubbing firmly into contact. Now paste and apply.

the lining papers, and put the cover under a board, subjected to light pressure, till dry and hard.

When dry, holes may be cut, and eyelets inserted to hold strings or elastic, if required. In cutting the triangular pieces from the corners of the covering paper, it should be noticed that the line of the cut passes through a point at a distance from the corner equal to the thickness of the card. This ensures the paper just meeting, and forming the mitre line on the inside face of the card.

Corner Bracket (Fig. 9).—This corner bracket introduces bending of card, binding on a curved surface, and the fastening on of rings. On the grounds of economy, strength, and ease in construction, it will be better that the bottom and sides should be made of wood-pulp board, while the front should be made from flexible card. The flexible card is more costly than the wood pulp, and moreover the purpose of using it will be more impressed upon the children when only the curved part is made from the special material. In such a case as this, and on a first attempt, the cutting of darts in the cloth is advisable, instead of attempting to stretch it sufficiently to make it lie flat on the card.

This model permits of a great deal of variation. The back may be raised higher, thus giving opportunities for design, as applied to the shape, and the front piece may also be shaped instead of straight. The bracket may be turned upside-down to make a shelf, in which case the front would be made somewhat narrower, and would act as a support for the front edge of the shelf. In the place of rings, holes may be punched, and eyeletted to form a means of support. The edges may all be bound with cloth, or covered with paper; but whenever rings are used, they should be fastened before the back covering paper is affixed.

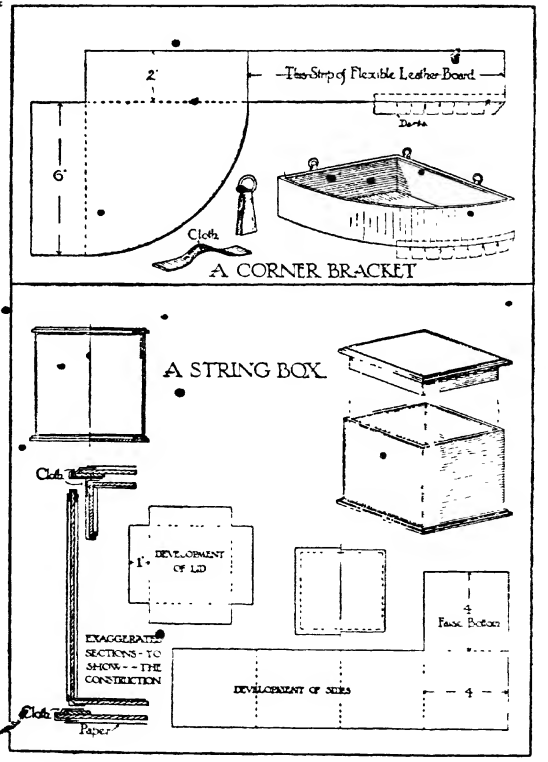
String Box (Fig. 10).—This string box illustrates a constructional device frequently met with, namely, the use of a false bottom and top for the purpose of holding the sides to the real bottom and top. It also introduces a simple form of built-up moulding. One method of developing the sides and the bottom of the box in one piece is shown, but a more economical way is to cut the piece for the false bottom quite separately. In this case it is put inside, after the vertical edges have been joined up

with cloth. The bottom is then bound with cloth all round, and a much stronger result is also secured. Fitting the frame of the lid inside the box prevents the joint between the box and the lid from showing.

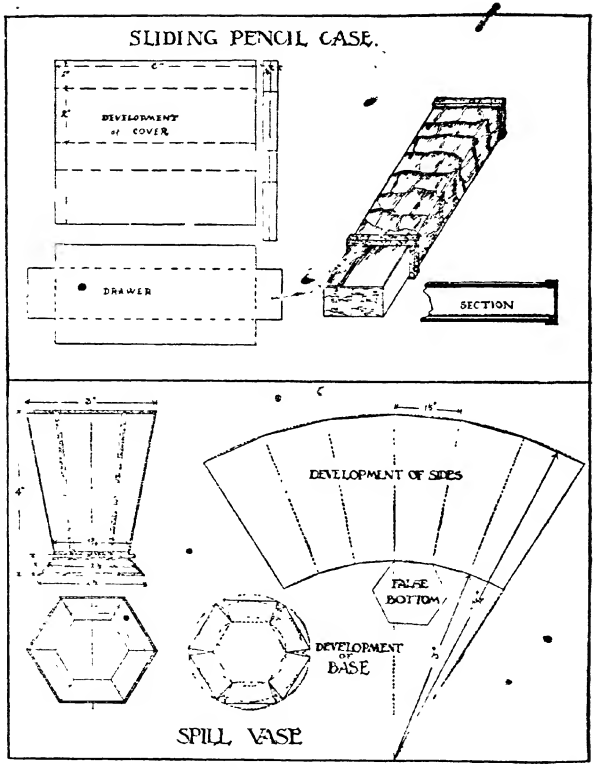
The eyelet for the string should be placed sufficiently far down to avoid interference with the frame of the lid. Some prefer the eyelet to be placed in the middle of the lid. In such a case as this two eyelets would have to be placed in the lid, one in the outer card, and one in the false top, before the two parts are glued together. Generally, in the gluing of the false and the true top and the false and true bottom together, it is not advisable to glue more of the surface than about $\frac{1}{2}$ in. in width all round. This gives ample strength, and the damping of the card all over, which would often tend to deform it badly, is avoided.

Sliding Pencil Case (Fig. 11).—This model shows the making of a sliding drawer, and the strengthening of the ends of the outer part by adding ribs about $\frac{1}{4}$ in. wide. These ribs should each be bound with cloth in one piece, the stretching of which, so that it will take the form required to fit over the projection and fold inside without any cutting away, provides a good exercise. The ends of the drawer should be strongly bound by taking a piece of cloth, as wide as the front is high, and long enough to cover all the front and return some little distance along the sides. If both ends of the cover are open, the drawer can be pushed out either way; but if one end is closed, a ring or handle or cloth tab, with which to pull out the drawer, will need to be fixed to the outer end. The cloth tab may be glued to the under side of the drawer before the bottom paper is put on; but if a ring is used, it is better to pierce the front, pass the cloth holding the ring right through, and glue it on to the inside, before the drawer is lined.

Spill Vase (Fig. 12).—In the construction of this model two methods of developing a truncated pyramid have been employed. In the case of the body of the vase, where the sides are large compared with the base, the method adopted, on the ground of economy of material and labour, is that of radiating lines. On the other hand, in developing the bottom part, the same reason has prompted the adoption of the folding-down method of develop-



FIGS. 9 AND 10



FIGS. 11 AND 12

ment. The construction gives a good opportunity for comparison of these two methods, and for consideration of the circumstances which should decide the method to be employed in any particular case.

At this stage the edges might be bound with coloured cloth, and the sides panelled with the covering paper.

Hinged Manuscript Covers (Fig. 13).—The making of these covers introduces the management of large pieces of paper, the binding of corners with cloth for greater strength, and the making of another form of hinge. The cloth for the joint is all in one piece, and passes right round the narrow strip of card, which is punched, eyeletted, and laced to the sheets to be covered. A little inspection of the drawings will show the arrangement of the cloth, and the manipulation that is necessary.

Cylindrical Case (Fig. 14).—This model shows one application of the making of a cylinder. In this case a roll of about 2 in. diameter will be useful. If some particular size for which a roll is not available is needed, a somewhat smaller one can be increased to some extent by increasing the quantity of newspaper rolled on it. As explained in dealing with the making of a cylinder, the roll in every case will be covered with dry newspaper to begin with. An examination of the sections will show that the model consists of two cylinders, one inside of the other, the inner one comparatively thin, and the outer one stronger and thicker. It will also be seen that paper and cloth have to be folded between them in the process of making.

As the first step, make on the roll a lined cylinder for the inner part. This may be either of brown or other stiff paper wound several times round the roll, or of carton or very thin card carried twice round. Now repeat the process on the roll enlarged by the cylinder just produced, first wrapping round it two or three thicknesses of dry newspaper, and then the flexible card for the body. If the card is of moderate thickness, it will be enough if this is carried twice round and allowance is made for the lap. The number of times that the card will have to be carried round to secure the necessary strength will depend upon its thinness. Be careful to thin out the card at each end for a distance equal to the lap. When this has been pasted and rolled,

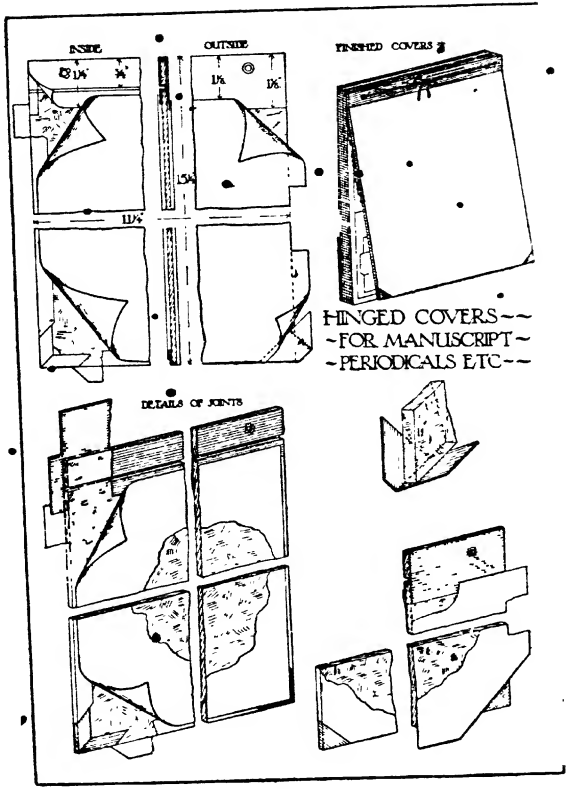

INSIDE
OUTSIDE
FINISHED COVERS
HINGED COVERS~~
~FOR MANUSCRIPT~
~PERIODICALS ETC~~
DETAILS OF JOINTS

FIG. 13

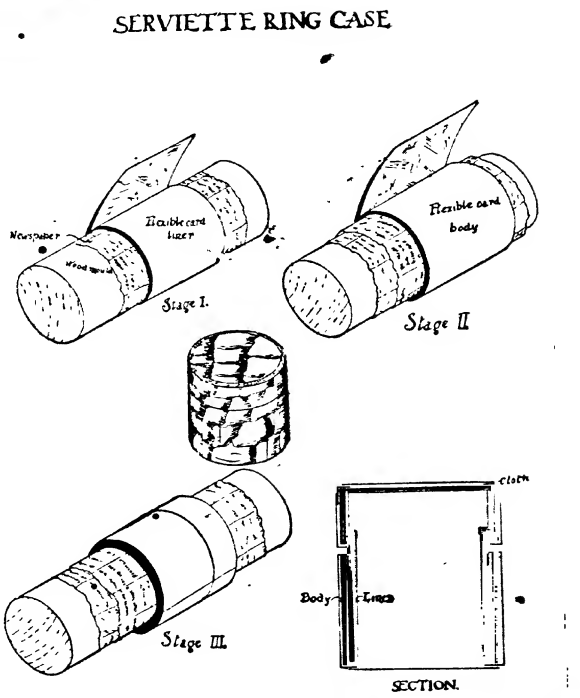

SERVIETTE RING CASE
Newspaper
Flexible card liner
Stage I.
Flexible card body
Stage II
Stage III.
cloth
Body
SECTION.

FIG. 14

cover it again with newspaper to hold it down tightly, and leave it to dry.

When quite dry and hard, having first taken off the outside newspaper, mark out and cut the two ends to give the proper length. Also mark off, and cut apart the portion for the lid, taking care not to cut the lining part, which is inside the body all the time. Now take off all these parts of the body, and having removed the newspaper from the outside of the liner, mark and cut it (liner) to the right size. Next cut two circular pieces of card, of such a size as to fit tightly into the ends of the outer cylinder, one for the top and the other for the bottom. Cover these with the lining paper before putting them in. Now put them in place, but a little too far in for their final positions. Next, having glued the inside of the bottom part of the outer cylinder for a distance at the end equal to the thickness of the card disc, hold the end of the cylinder firmly down on the board, and using the roll inside the cylinder, press the circular end piece out into a position flush with the end. Repeat this for the lid.

While the ends are drying, cover that part of the outside of the liner that would otherwise be seen when it is in place. The covering paper should be turned over the top end, but it need go only just inside, as the inner surface of the liner has already been covered with paper before rolling. If considered necessary, the edges of the circular ends may be bound with cloth, as shown in the case of the lid in the illustration. Otherwise the paper cover will fold round the edges, as shown at the bottom. A circle of covering paper is always necessary at both the top and the bottom. Next line the inside of the lid with the lining paper. Finally, glue or paste the inside of the body—not the outside of the liner—gently force the liner down into position, and leave it to dry. Do not attempt to put the lid on to the box till the lining paper is quite dry, as this will almost certainly ruck up and be spoiled.

Other applications of the same operations will be found in making round cases, varying in size from a cylindrical thermometer case, for which a mould of the diameter of a lead pencil will serve, to a manuscript or music case, as large as 18 in. by 4 or 5 in. Cylinders of larger diameter, suitable for round, hollow boxes, will be made without the use of a mould, by cutting out a piece of

card sufficiently thick for one layer to give the requisite strength, and joining two edges by a long lap. The desired shape—circular, elliptical, or oval—will be easily secured by the insertion of the false bottom and top, which should fit tightly. A further reduction in depth gives shallow boxes and trays, which will be made in the same way.

Octagonal Collar Box (Fig. 15).—This box is one of considerable utility, and may be so designed as to provide an instance of a hollow moulding. The only point of difficulty is the determination of the length of the sides for the liner. The best way to do this is to set out the plan of the box, showing the thickness of the material to be used for the sides, and to draw lines from the angular points to the centre. Then measure, by means of dividers, the distance between the radial lines along the outer surface of one of the sides of the body of the box, as shown in the plan. This will give the length of the side of the outer part. Similarly, the length of the sides of the liner may be got by measuring the distance between the radial lines along the inner surface of one of the sides of the body. The model may be made with five, six, seven, eight, or more sides, as fancy may dictate. A good test for accuracy is to see that the lid will fit on equally well in every possible position.

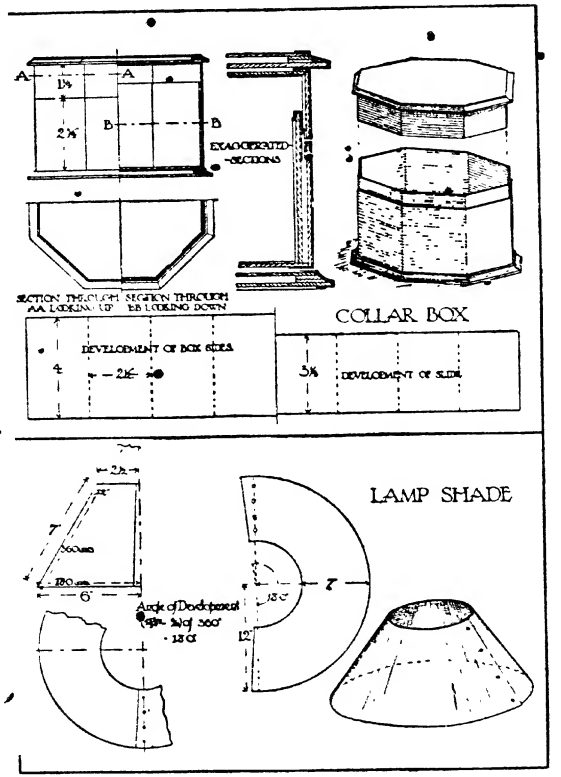
To the inexperienced the hint may be given to set out the development of all the sides of both the outer part of the box and the lid on one piece of card, then to make the half cuts for the angles right across, and afterwards to separate the piece for the rim of the lid.

Lamp Shade (Fig. 16).—This model introduces the development of the cone. It is necessary to know that the developed envelope of a cone is a sector of a circle whose radius is equal in length to the slant side of that cone. If the children do not know this, it can be demonstrated quite easily by rolling a cone on a piece of paper, and drawing attention to the fact that successive generators lie on the paper, and that all these generators are of equal length. As the vertex of the cone remains in one place, the shape of the developed envelope must be a circle, since, by definition, a circle is a figure such that every point in its circumference is at a constant distance from a fixed point. An

elevation of the cone will give the radius of the sector, as the slant side of the triangle. The only difficulty usually experienced is to know how to determine the angle of the sector in any particular case. It will be apparent that the distance round the circular base of the cone will be also the distance round the circle of the developed envelope.

The method most commonly suggested is to take a small length with compasses, and to step this off along the circle of the developed envelope the same number of times that it will go along the circular base of the cone. This can never be absolutely correct, and can only be approximately so when a very flat cone is being dealt with, and the method should not be taught as anything better than a makeshift. Children who are old enough to realise that the circumference of a circle is proportional to its radius, and that the angles at the centre of a circle are proportional to the arcs which subtend them, will experience no difficulty in grasping the following correct method, which may in any case be adopted, even if proof of its validity be omitted. Starting from the two principles just stated, it may be easily demonstrated that the angle at the centre of the development circle, which will cut off from the circumference of that circle a length of arc equal to the circumference of the circular base of the cone, will be that fraction of 360° whose numerator is the radius of the circular base of the cone, and whose denominator is the radius of the development circle, that is, the length of the slant side of the cone. Thus, in the example illustrated, the radius of the base is 6 in., the radius of the development, which is equivalent to the slant side of the cone, is 12 in., and the development angle is $\frac{6}{12}$ of 360°, or 180°.

Children who have reached this stage will have no difficulty in setting out the angle. A protractor may be used, but far better is the use of a table of chords. A set of three-figure tables can be bought for a penny, and will give greater accuracy in figures than the human eye, unaided, can hope to achieve in measurement. Yet we still find teachers advising pupils to buy, and themselves requisitioning from educational authorities, wooden and other protractors, varying in price from 6*d.* to 10*s.* 6*d.*, which are cumbersome to carry about, are easily broken, and in the case of the cheaper varieties are very inaccurate.



FIGS. 15 AND 16

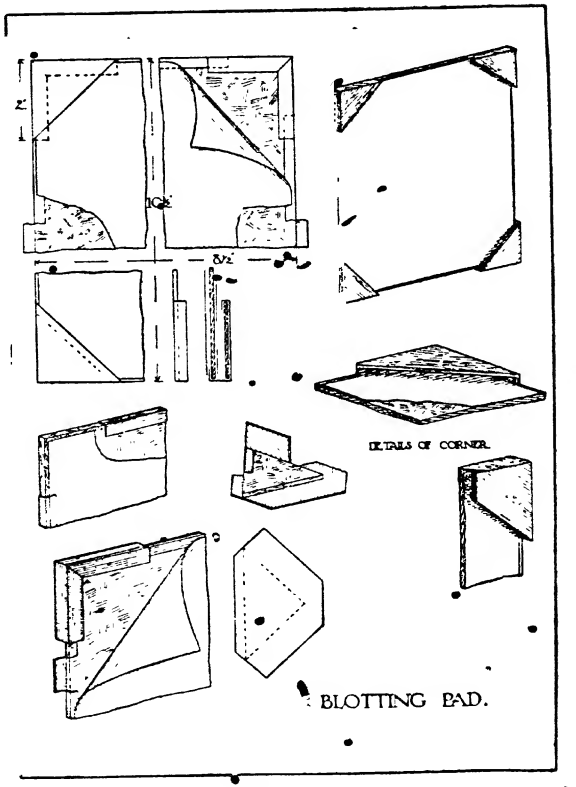


FIG. 17

In the particular case illustrated no setting out of the angle is necessary, as, the angle of the development being 180°, the two radii are in the same straight line. Advantage should always be taken of the ordinary mechanical methods of making angles of 45°, 60°, 90°, 120°, and 135°, and so on. Again, when using the tables, a small angle may be set out with a greater degree of accuracy. Hence, instead of setting out directly the actual angle required, it is sometimes preferable to set out by such a mechanical method the nearest of the above angles, and then to set out, from the information in the tables, the difference between this and the required angle.

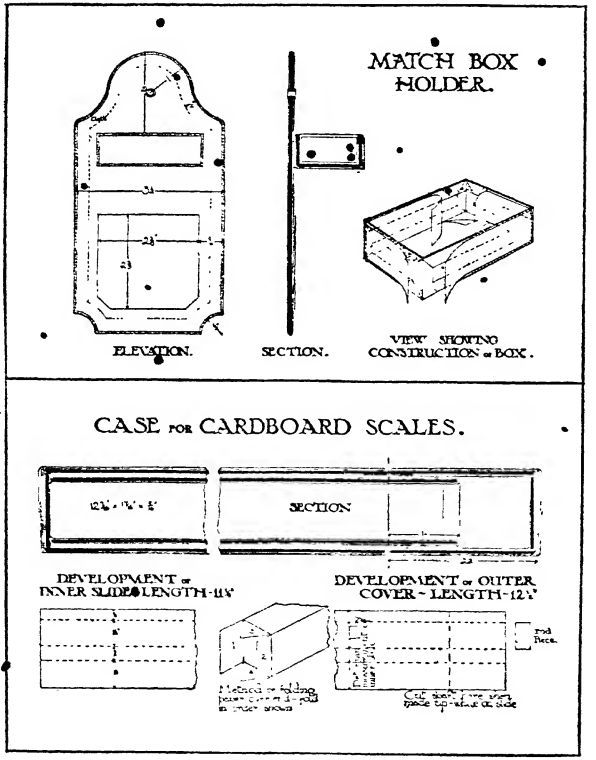
If a graphic method of determining the angle of the development is preferred, it is only necessary to set off along the slant side of the cone, from the base angle, a distance representing 360 units, and from the point thus obtained to draw a line parallel to the axis of the cone so as to cut the base. The distance between the point of intersection and the same base angle, expressed in the same units, will give the number of degrees in the angle of the development.

The line for the top of the truncated part will be a concentric circle, whose radius will also be equal to the slant side of the top cone, and can be obtained from the elevation. Having obtained the shape and position of the joint line, the bottom edge may be ornamented by various shapings, if desired.

With regard to material, a green shade of carton answers well, and the joint may be made by pasting, by eyeletting, by lacing, or tying with cords or silk ribbon.

Blotting Pad (Fig. 17).—This model requires little explanation. Pieces of thick card, on which to model the cloth corner pieces, may be placed at the angles. These packing pieces may well be left in till the paste is quite dry; but before putting away, it is well to make sure that no stray paste is getting such a hold upon them as to fix them permanently. It is quite surprising how very strongly the paste will hold at times. It should be observed that the cloth edging only goes sufficiently near the angles to be covered by the cloth corners.

Match-box Holder (Fig. 18).—This model is only one of many that may be used to introduce the binding of a concave edge.



FIGS. 18 AND 19

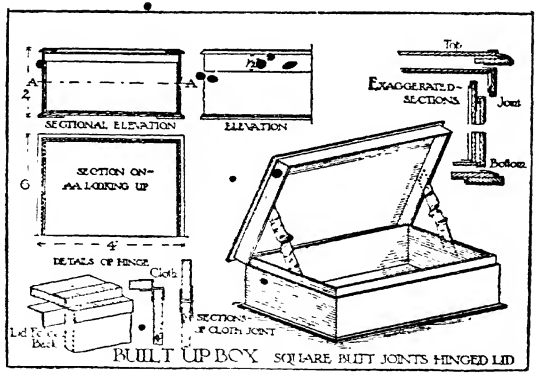


FIG. 20

The piece of glass paper for the match striker should be set out, and cut with a knife from the paper side.

Case for Cardboard Scales (Fig. 19).—This model introduces a similar method of working to that pursued in the case of the cylinder, but a rectangular mould is used instead of a circular one. The steps in the work are the same, except that the card having been set out, it will be joined with cloth at one of the angles, half cuts being made at the others. The exaggerated section shows the method of putting the case together.

Built-up Box (Fig. 20).—This box is built of thick card. It is constructed with square butt joints bound with cloth, which method gives the most exact and finished results. The lid is hinged, and the box has a built-up base and top, with moulded edges. The silk tapes or ribbons to prevent the lid straining the hinge, by opening too far, are stuck on before the lining paper is put in, and this covers any unsightliness due to the ends of the ribbons. Such a box as this, when well made, is quite worthy of a good covering paper, and, properly used, will probably have a long life.

Removable Cover for Books (Fig. 21).—In these days of lending libraries this model may be considered superfluous, but there are still many people who treasure books of their own. From want of time to read them at home or from a desire to relieve the tediousness of the daily journey by train or tram, they may desire to carry them about. To such as these a cover like this will be welcome. It easily slips over the permanent cover of a book and saves it from injury. An allowance of $\frac{1}{4}$ in. in length and width should be made, to permit it to go on without strain. The sides are of two thicknesses of card. The outer cards, with the cloth back, are made up like a folio cover; the inner cards are lined, and the cloth pockets made on them, room for the insertion of the book covers being secured by putting a packing piece of thick card in each pocket while making it. The outer and inner boards are then glued together. Tape or cloth handles can be added to the outer boards before fixing together, by piercing the boards, passing the tapes through, and gluing on the inside. These are at times handy for carrying purposes.

Hairpin Tidy (Fig. 22).—This is a more intricate model. It

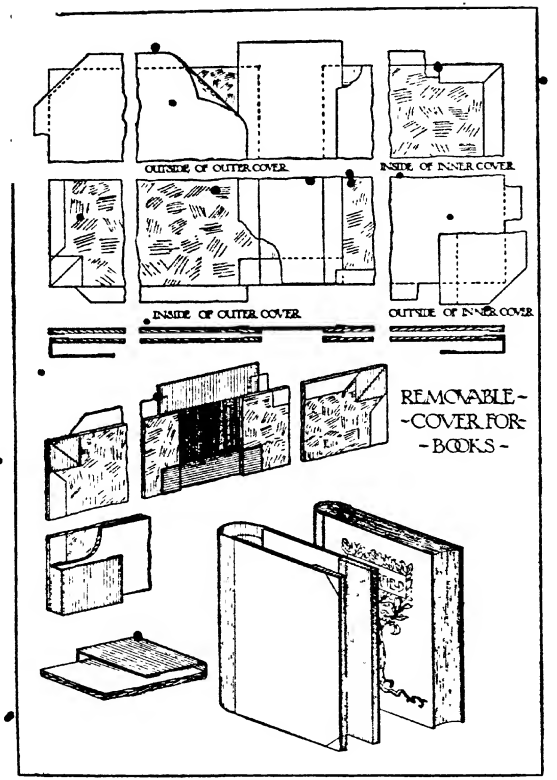

OUTSIDE OF OUTER COVER
INSIDE OF INNER COVER
INSIDE OF OUTER COVER
OUTSIDE OF INNER COVER
REMOVABLE-
-COVER FOR-
-BOOKS-

FIG. 21

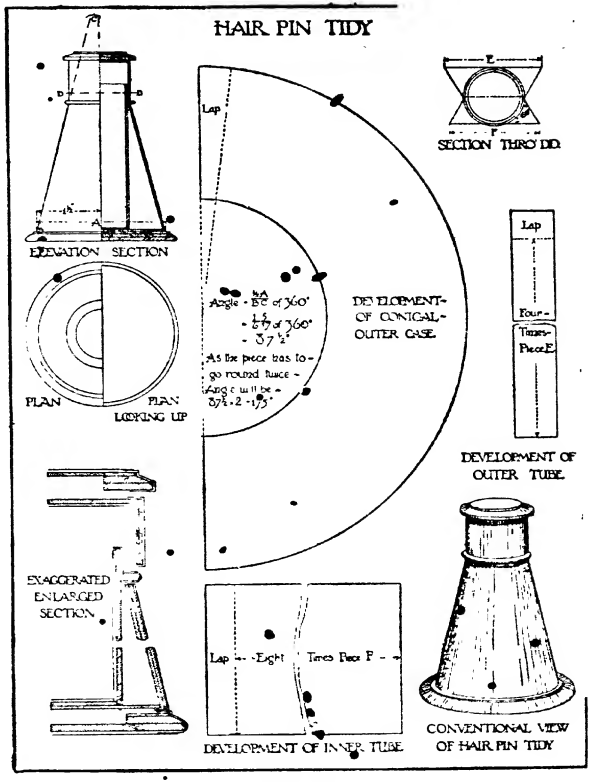

HAIR PIN TIDY
ELEVATION
SECTION
PLAN
PLAN
LOOKING UP
Lap
DEVELOPMENT
OF CONICAL
OUTER CASE
SECTION THRO' DD
Lap
Four
Times
Piece E
DEVELOPMENT OF
OUTER TUBE
EXAGGERATED
ENLARGED
SECTION
Lap
Eight
Times Piece F
DEVELOPMENT OF INNER TUBE
CONVENTIONAL VIEW
OF HAIR PIN TIDY

FIG. 22

may be varied so as to provide good examples for the application of geometry and mensuration, as well as exercise in the manipulation of material. An approximately correct graphical method of determining the circumference of a circle is given.

Trinket Box (Fig. 23).—This model introduces the development of a curved surface, and of the intersection line on it for the joint at the angle. It also introduces the use of V cuts in bending. At this stage the card should be cut to a mitre in its thickness, where the edges come together at the angles. This gives a better finish, and a truer fit. The card for the body should be developed in one piece, and the sides should be moulded to the required curve with a bone folder, before gluing up. The lid is built up so as to form a rebate on its under side, but it is not hinged.

Hat-pin Stand (Fig. 24).—This gives further practice in the development of curved sides. It also introduces more intricate moulding, and an oblique section of the curved body, and illustrates a piece of very practically useful geometrical construction. The method of working from the centre lines of the sides will be found easiest in practice.

The Purpose of the Course of Work Illustrated.—It will be well, perhaps, to point out here that this series of models, suggested as suitable for seniors, is not intended to be taken, just as here set out, as a scheme of work suitable for any class. The intention has been to give to teachers some information concerning the principles of construction applicable to cardboard and the processes involved in working that material, and to deal with a few—indeed, very few—examples of useful, interesting objects, in the making of which those principles and processes may be actually applied. Such a course would be very suitable for teachers anxious to acquire skill and knowledge of the work, who, when thus equipped, would find no difficulty in applying their new knowledge in the illustration of geometry, mathematics, geography, and other subjects. There is, however, in the course, no model that an intelligent child of fifteen or sixteen would not be able to make satisfactorily, if properly taught. If a similar course of models is adopted for children, it will be necessary, at practically every stage, to ease the gradation of difficulty by introducing a number of other models between those suggested.

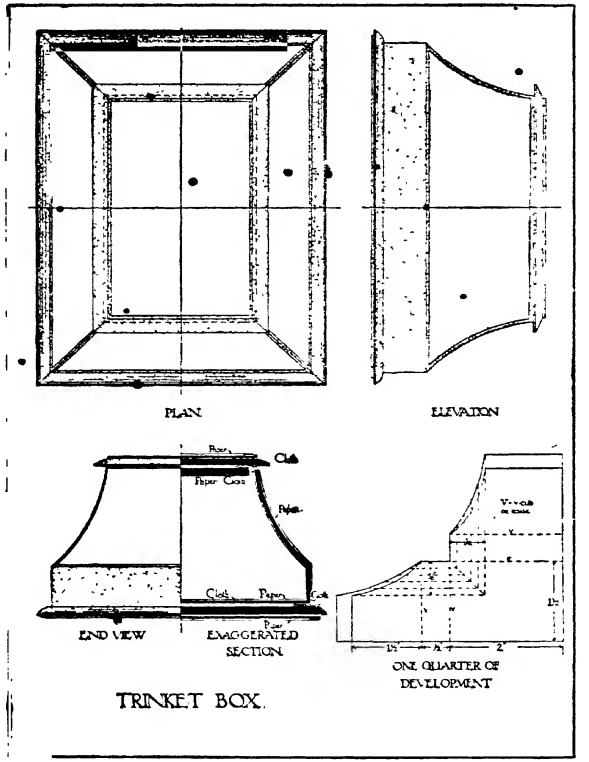

PLAN
ELEVATION
Paper
Cloth
Paper Core
Pipe
Cloth
Paper
Core
Pipe
END VIEW
EXAGGERATED SECTION
Veneer or Card
ONE QUARTER OF DEVELOPMENT
TRINKET BOX.

FIG. 23

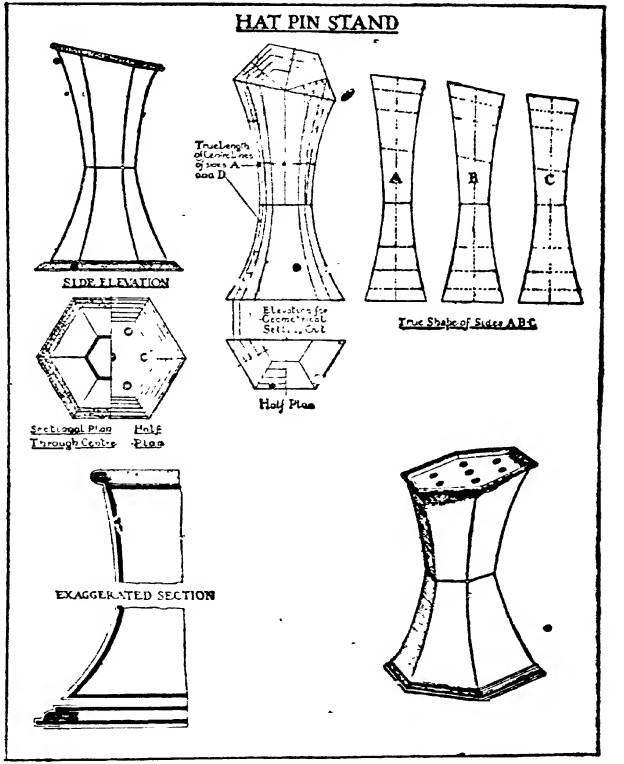

HAT PIN STAND
SIDE ELEVATION
True Length of Corner Lines of Sides A and D
Elevations for Geometrical Setting Out
Half Plan
A
B
C
True Shape of Sides A B C
Sectional Plan Through Centre
Half Plan
EXAGGERATED SECTION

FIG. 24

Also, if the course is to be an ideal one, the models will vary with every class, and even to some extent with every child in a class, and must fit in with the interest of the moment, both of the class and of the individual. Only by these means can the maximum of real living interest be attained.

Many of the difficulties of gradation will be overcome if this interest is secured. It is sometimes quite astonishing to see the skill developed by a child who has been induced to put forth a real effort to attain some desired end. It is the "Don't think it necessary" attitude on the part of either the child or the teacher which is so often the cause of failure to reach the high standard of excellence which might frequently be attained.

Cardboard Work in its Substantive and Instrumental Aspects.—Again, a broad difference must be made in the teaching method, and in the selection of suitable objects, according to the purpose which is to govern the work.

Where the main purpose of the work is to develop the child's intelligence by the exercise of his constructive instinct and by the thoughtful and purposeful use of his hands on some material; to show him, through the medium of objects which he will make for other than school use, that his geometry, his mensuration, and his arithmetic are of real use to him in the world; to train him to an appreciation of a high standard of beauty and finish; to give him real evidence that his art work has a meaning and use and should be applied to things in everyday life; and to teach him that use and suitability to purpose and material are the great governing factors in deciding what is good in art, there the main thought and effort will be directed to producing a well-made, finely finished, and beautiful piece of work, and the arithmetic, geometry, and science will only be brought into play when they help towards that end.

Where, however, the chief purpose of the work is to help the child to grasp some truth in arithmetic, mensuration, or geometry, the chief aim will be the making, in the time available, of a maximum number of examples to illustrate the truth. The handwork introduced will be restricted as far as possible to such manipulation of the material as will be immediately helpful in elucidating the principles to be taught.

Most teachers, at the present time, will possibly think it best to compromise between these two aims, and will desire, as much as possible, to reap the advantages to be derived from both. Hence, while at times, perhaps, paper and card work will be dealt with as a regular subject of the school curriculum, at others the work will be made subservient to the special claims of other subjects, and according to the general purpose, so the differences in method indicated will become more or less obvious.

The Development of Initiative.—The treatment of the children will need to vary greatly according to their previous training. If they have been familiar with handwork from the infants' school upwards, and have learnt to realise that every lesson is to be regarded as bringing a problem for *them* to solve; that when an interesting object is suggested, it is for *them*, if possible, to find out how *they* can make it, and that the teacher is to be regarded as guide, counsellor, and friend in the matter; that they should take full advantage of such liberty as is given them to design and arrange a model in accordance with their own taste and their own interpretation of the aim, but that when liberty is not given, there must be rigid adherence to the conditions laid down,—in such circumstances little difficulty will be experienced in quickening into life the real heuristic spirit. In other cases more decided steps will be necessary to prevent children from simply copying others, or imitating without thought what the teacher has done.

Under healthy conditions children will overflow with suggestions, which may or may not be practicable, and which consequently may or may not be allowed. There may be occasions when it will be advisable for a child to be allowed to spoil his work, but generally it is a bad policy to allow a child to attempt what must inevitably fail. Nothing succeeds like success, and nothing destroys confidence like repeated or hopeless failure. Again, while it is necessary to permit opportunities for expression, and to encourage the exercise of initiative at the cost of occasional failure, never, if possible, should a piece of bad work be allowed to pass uncriticised. Instinctive appreciation of beautiful things comes, primarily, from close and constant association with them. When such appreciation has been established, the power of discrimination may be made more definite and sure by being occasion-

ally confronted with bad examples. Children especially need to be constantly surrounded by what is lovely and beautiful, if the desire for it is to grow in them. Nothing in their environment can more powerfully affect them than an object in which their deep interest has been aroused by the exercise of their constructive instinct—that which they themselves have made. Suggestions, then, should, as a rule, be submitted to the teacher before they are incorporated in a piece of work, so that the final form may be as far as possible free from fault, consistently with its representing ideas that have had their birth in the minds of the children themselves.

It must be remembered, however, that a child can seldom think in terms of the material used, or realise in detail the object to be made. The effect of a curve, as a line drawn by itself on a piece of paper, is not the same as the effect of the curve cut out in material and put in combination with other parts of an object. Nor is a joint, as such, quite the same as when applied in the making of an article of use, where its essential characteristics are displayed. Therefore, it will be very necessary that the children's suggestions should be made in concrete form, not merely in words, or even by drawings, unless the suggestions are clearly realised, and the words or drawings have a real meaning to the children concerned.

Having received suggestions from the children in the form indicated, the teacher would naturally endeavour to obtain a verbal description, together with a statement of reasons, if such can be given. The putting by the pupil of thoughts into words will often be quite sufficient, without the need of comment from the teacher, to decide the question of the adoption of a suggestion. It means a marshalling of facts, and a true estimate of their relative importance, which, though it takes up time, is of the greatest value in view of the immediate object, and at the same time helps to form the habit of self-criticism.

The intimate connections possible between cardboard work and geometry, arithmetic, mensuration, mechanics, geography, history, art, and nature study are very real and of great importance, and are dealt with in other articles.

Materials and Cost.—The materials used in early work are few

and cheap. As the work proceeds, new materials are required, but none drop entirely out of use, so that a considerable variety will be in use in advanced work. Any secondhand material that really serves the purpose in view may often be used to advantage, and will show at the same time how other waste material may be put to profitable employment. Drapers' and milliners' card boxes can often be obtained at a cost much below that of the material alone, of which they are made, if this were purchased at first hand. Sometimes it may be had for nothing. One may see, any day, such material being carried away as rubbish, in the dust-carts of our towns. Such waste material would provide the means for very profitable employment for many of our girls and boys, if these only had the skill and knowledge to use it. In fact, there are few school occupations that can provide such attractive and profitable employment with such small need of equipment and apparatus, as this which we are considering.

WRAPPING AND CARTRIDGE PAPERS.—The first of the new materials used in early work will most probably be one of the Wrapping or Cartridge Papers. *Cartridge paper* is usually sold by the ream, and the thickness is indicated by a stated size and weight. It may be obtained in white, or tinted with one of several colours. Grey is most common. It may be had cut into squares with 6-in., 8-in., 10-in., or 12-in. sides, and done up in packets of one hundred. Other sizes or shapes may be had cut to order, or a guillotine may be purchased, and then any size the teacher needs for class purposes can be quickly cut. If there is much use for it, such a machine would soon pay for itself. *Brown wrapping paper* will be found very useful. It may be purchased in several shades, textures, and thicknesses. It may be had in continuous rolls 60 in. wide; in sheets 46 in. by 36 in. (known in the trade as "casing"); in Double Imperial sheets 45 in. by 29 in.; in Imperial sheets, or in other stock sizes; or it may be cut into squares of any size, as in the case of cartridge paper. The wholesale price of 10-in. squares of a serviceable paper is from 2*d.* to 3*d.* per hundred sheets. The price, however, is usually quoted per ream of a given weight, the sheets being of some standard size, and an addition is made for cutting. Thus "Double Imperial brown wrapping, 29 by 45, 60 lb. @ 8*s.*, 80 lb. @ 10*s.* 6*d.*,

120 lb. @ 15*s.* 6*d.*, 140 lb. @ 18*s.*, and 200 lb. @ 26*s.*," is from a wholesale list, and means, for instance, that 480 sheets of brown paper weighing 60 lb. and measuring 29 in. by 45 in. would be sold for 8*s.*, or at less than 2½*d.* per dozen of such large sheets. The retail price is, of course, much higher.

Manilla paper is another useful paper. It is very strong, and therefore can be used much thinner than brown paper, while still giving the same strength. It is somewhat higher in price than brown paper, and is usually buff or blue in colour, and glazed on one side.

CARTON.—The next material in order of thickness is carton. The best quality is close in texture, and felted in one thickness, so that it does not split easily into layers like ordinary cardboard, and it is coloured all through alike. It is less likely than ordinary card to crack in bending. On the other hand, it is more costly than other kinds, and the advantage for young children perhaps hardly justifies the extra cost. It is made in several thicknesses, the thinnest being only a little thicker than stout paper.

CARDBOARDS.—The most generally useful cardboard for school use is that known as "wood pulp." It is usually sold in Imperial sheets by the hundredweight, and can be bought at prices ranging from about 10*s.* per hundredweight. The thickness is given by indication of the number of sheets in a hundredweight. The thicknesses made are those indicated by the numbers 60, 70, 80, 100, 140, 180, 200, 250, 300, 400, 450, 500, 600. The numbers 80, 140, and 200 correspond approximately to a thick, a medium, and a thin card respectively, suitable for ordinary work. It is of a dirty white colour, cuts fairly easily and without dulling the knife quickly, bends moderately well, and splits easily along its laminations. When joined with glue or paste, the strength of the joint is greater than that of the material. It may be had as "tinted boards," in which case a very thin tinted paper is pasted to both sides. It is then usually sold by the gross at prices ranging from 7*s.* 6*d.* upwards. If different colours are used on the two sides a higher price is charged, and the cards are sometimes called "duplex cards."

Rasteboards are a better quality of card, and are more costly.

They are more frequently used for mounts than wood pulp, being of a better colour.

Strawboards are a strong, cheap kind of board, yellow-brown in colour, and a good deal harder than pulp boards. They have the serious disadvantage for children's work of taking the edge off the knife very quickly.

Patent flexible leather boards are a special kind of board made for curved work. They are slightly more costly than wood-pulp boards, but are tougher, and less likely to split. They can be used with advantage in ordinary classes in association with wood pulp, for the purpose of bent work.

Millboards are a kind of card made from rope, very heavily rolled, and consequently hard and tough. They are used for the stiff covers of heavy books, and for the sides and bottoms of some boxes. In school work some kinds are used as cutting boards. The harder kinds answer this purpose very well, and are cheap.

CLOTHS.—The cloth used for binding and covering the card, as well as for making joints and hinges, will be one of the several kinds of :

Bookbinders' Cloths.—This material is made of a cotton or linen fabric, heavily loaded to give it density. The ordinary bookbinders' cloth can be had in practically any colour, and either plain or embossed, glazed or with a dull finish. Some of those with embossed patterns have a beautiful effect when tastefully used, and only cost about ½*d.* a yard more than the plain kinds. The cloth is usually 36 or 38 in. wide, and the pieces measure 36 or 38 yds. in length. The ordinary price is about 7*d.* per yard. *Art linen cloth* of admirable finish and quality can be had from 1*s.* a yard, *art canvas* at 9*d.*, *art vellum* at 1*s.*, and *foril cloth* at 10*d.* *Box union cloth* in white, green, or buff can be had at 6*d.* to 9*d.* per yard.

Imitation leather of several kinds, in many colours, and with various designs, can be bought at prices ranging from 1*s.* 9*d.* to 2*s.* 9*d.* per yard.

White tape for bookbinding can be had ½ in. wide, from 8*s.* per gross of pieces 9 yds. long, or on a reel of 1,000 yds. of tape from 4*s.* upwards.

OTHER COVERING MATERIALS.—The covering materials which

may be used in this work range from a plain common coloured paper, at as low a cost as 2*s.* 6*d.* a ream, to quite costly leathers specially prepared for bookbinding and similar work. The price for the same papers will vary greatly. When stock quantities, such as reams, are obtained from the wholesale merchant, the prices are astonishingly low; but when quires of assorted papers or even single sheets are ordered, the price is just as surprisingly high. It will often be economical to purchase a ream, even if there is little likelihood of using the whole of it, rather than order a smaller quantity. A strict observance of business methods must obtain when dealing with wholesale houses, if full advantage is to be obtained.

A very brief description of a few of those covering materials most commonly used may be of some service.

The sizes that may be most commonly obtained in fancy papers are foolscap, 13½ in. × 17 in.; copy, 16½ in. × 20 in.; demy, 18 in. × 22½ in.; royal, 20 in. × 25 in.; and double crown, 20 in. × 30 in. Of these, royal is the one most frequently required, and will be the size referred to when prices are mentioned. If other than a stock size is ordered, it must be remembered that the next size larger, from which the sheets can be cut, and the cost of cutting must be paid for.

(i) *Marble Papers.*—These can be obtained in about 150 designs. English marbles are the best, and range in price from 2*s.* a quire, or 38*s.* a ream, to 6*s.* a quire, or £6 10*s.* a ream. Cheaper qualities can be had, as low as 8*s.* 6*d.* a ream. These marble papers will be found good papers for much early work in covering boxes, folio covers, trays, and other objects. They are easy to manipulate, and do not readily soil on the face. They are usually glazed with a very shiny and smooth surface, and consequently are specially valuable for covering any sliding parts, such as the sides of drawers or pencil cases.

(ii) *Flint Glazed Papers.*—These are papers that can be obtained in almost every colour and with a hard glazed surface. They also are well adapted for sliding parts, and for bottoms of boxes and trays, where a paper that will not readily soil is advisable. They are also valuable, for the same reason, for covering geometrical models that will be likely to have much handling in use after

being made. Their surfaces may be sponged with water without disturbing the colour. The price for such papers will range from 7*s.* a ream upwards. The colour, as well as the quality, will cause a difference in the price.

(iii) *Surface Coloured Papers.*—These can be obtained in a similar extensive range of colours, and, if desired, with a dull finish, the price being also from 7*s.* to 30*s.* a ream. They also will be found useful for any geometrical figures, and for similar work, where fancy designs would be inappropriate.

(iv) *Printed Design End Papers.*—These are made for the fly-leaves of books. They are white on one side and have a pattern in one colour printed on the other. They are a strong, useful class of paper, adapted not only for their special purpose, but for linings of boxes and cases generally. Their price ranges from about 14*s.* a ream upwards.

(v) *Brocade End Papers.*—These are made to serve the same purpose in the book trade. They are made in more than fifty designs and colours, and range in price from 24*s.* to £5 a ream. Some of them are very rich and beautiful. Those containing most gold in the design are most costly. They are excellent papers for the more advanced work, for covering almost any article of ornament or use. Tastefully employed, they will transform a plain card box into an artistic ornament that will be a delight to the maker or the recipient.

(vi) *Leather Papers.*—These are covering papers made to imitate the colour and grain of leathers, such as morocco, russia, or calf. Several qualities and thicknesses are made. They are generally embossed, or rolled to form a pattern, and finished with either a dull or a bright varnished surface. They are useful where a quieter effect is needed than the brocade would give. For the covering of books, vases, and other articles, they have an extensive range of usefulness. The price will range from 1*s.* 2*d.* a quire, or 18*s.* a ream, to £5 a ream. They may also be had in rolls of 12 or 36 yds., and 30 or 32 in. wide.

Other papers used include moiré, watered, linen, silk, embossed, leatherette cloth, and blotting papers.

INCIDENTAL MATERIALS.—Among other materials used incidentally in the work are the tapes, cords, and ribbons used for

lacing or tying, for making handles, or for ornament. They can be obtained from almost any fancy-work shop, and from most drapers. Prussian binding makes a good tape for the tying of folios. "Silko" cord is a cheap and useful coloured cord for lacing fancy articles together, and China silk ribbon in fancy shades produces a very pretty effect when used for suitable objects.

ADHESIVES.—There are many serviceable adhesives on the market. *Higgins's vegetable glue* is distinctly one of the best. It is clean, strong, and sets quickly, does not affect the colour of paper or cloth, and can be made thin with water for use with thin papers, or may be used as supplied by the manufacturer for heavy papers or cloth. Like many good things, however, it is rather costly, the retail price being 5½*d.* per half-pound tin.

Seccotine, fish glue, "*Fixquick,*" and other similar preparations have occasional use, but can be easily dispensed with. Ordinary glue is useful, either alone or mixed with paste, but requires a means of keeping it hot. This may take the form of a small gas ring for each bench. For use in schools it is necessary to have the flame protected by a metal envelope, and to arrange the glue pot so that if it boils over it does not put out the gas. Should this occur, with no one near, the room may soon be filled with gas, and dangerous accidents may result. The danger from fire and from other causes is so great, especially with young children, that as the glue can be dispensed with without much loss, it certainly seems advisable to use other adhesives in school work of this character.

Ordinary flour and starch paste are serviceable, but are slow in setting. They answer fairly well for papers, but do not "get hold" quickly enough for binding with cloth. *Paste made from rye flour* gives a very strong paste, but is dark in colour. *Shoemaker's paste* is made from this. There is some trouble in making these pastes, and they quickly turn sour or spoil, unless some preservative is put in them. Bi-chloride of mercury is most effective, but is dangerous, being a deadly poison. Oil of cloves or a similar essential oil will help.

A bookbinders' paste known as "*Stek-o*" is convenient and cheap. It is purchasable in the form of powder, in packets, at

5*d*. a pound, or more cheaply if bought in larger quantities. It only needs to be stirred into boiling water to the necessary consistency. One pound will make about a gallon of good paste. In the form of powder it keeps indefinitely, and after making up will keep good for weeks if left in an open vessel.

BOOKS FOR REFERENCE

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LVIII. LIGHT WOODWORK FOR COUNTRY SCHOOLS

(FOR INFANTS AND BEGINNERS)

By W. H. Turner

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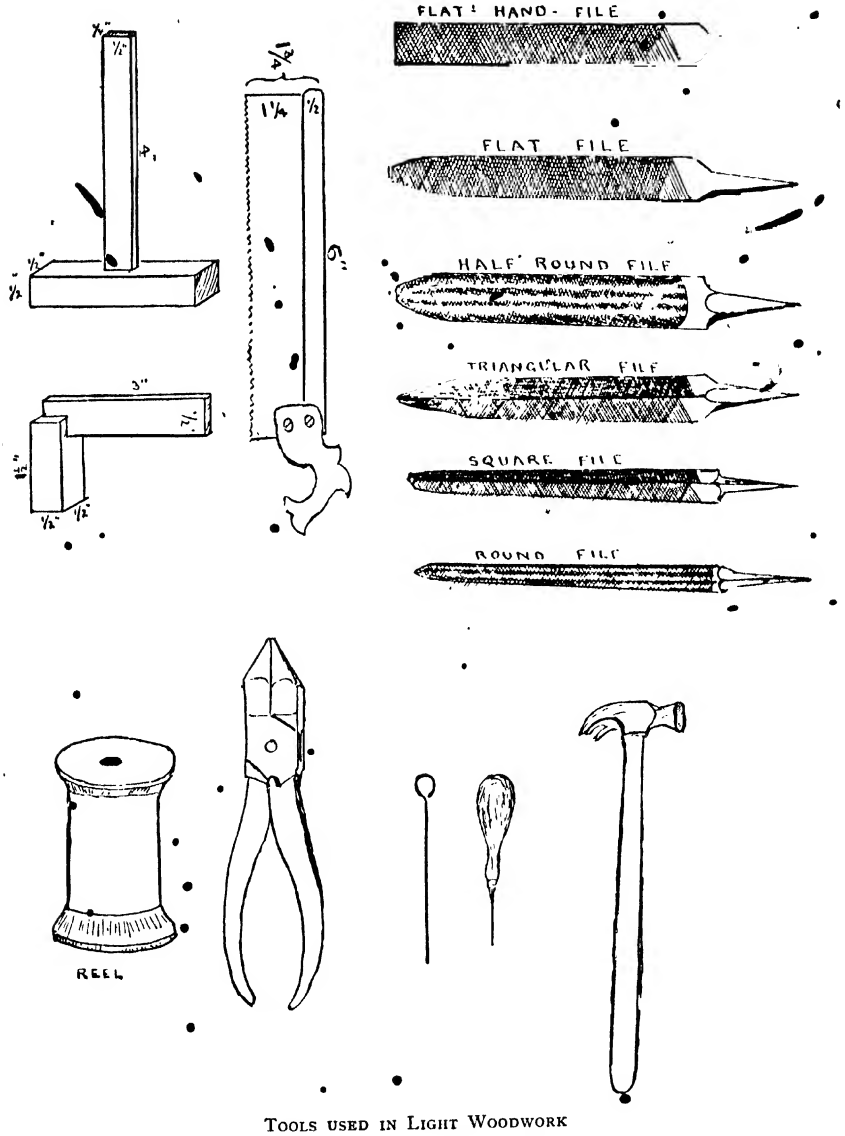
Special Needs of Country Schools.—In remote rural areas, where classes in woodwork for teachers are difficult, if not practically impossible, to work, and where, therefore, the simplest materials, tools, and system are necessary if any attempt at woodwork teaching is to be made, some special scheme is required which will meet these needs, and yet give all the chief elements of educational training which woodwork should yield. Such a scheme must be simple, inexpensive, and easy to master by both teachers and pupils, and yet a sound and scientific introduction to the highest forms of woodwork.

Scope of this Scheme.—The following scheme is offered as one that will fulfil these conditions in a satisfactory manner. It can be begun at the top of the infants' school, continued through the junior classes, and, in the absence of any other form of woodwork, developed in such a way as to lead to really good work in the senior classes. It has an organic structure and development in itself; brings out the powers of imitation, construction, and initiation in the children; and is full of interest, attraction, and usefulness, within the limits of the child's own life, desires, and instincts. The exercises here given are for beginners, but teachers should find little difficulty in extending the course.

Kinds of Timber Used.—The whole scheme is based upon the use of ordinary builder's laths, 1 in. by ¼ in., which are easily procurable everywhere and are very cheap. For all the early



TOOLS USED IN LIGHT WOODWORK

models the wood is supplied to the children in a planed and trued-up condition, and of the exact width and thickness required, but not of the right length. It is given out to the little learners

in lengths of from 15 to 18 in., according to the amount of desk space available for each pupil.

When, later on, any special width of lath is required for the more advanced models, the quicker and more skilful children of the junior and senior classes readily learn to cut it from wide boards, which should be kept in stock for the purpose.

Tools.—The special tools required are few and inexpensive. They are as follows: *a small wooden square*, which can be made by the older boys; *a brass-back saw* with a blade 6 in. long and $1\frac{1}{4}$ in. wide; *a child's sawing block*, or a special bench hook which can be made by the older boys; *bradawls*, an excellent substitute for which—in the majority of the early light woodwork models, in which only the shortest and finest nails are used—is found in ordinary short steel meat skewers 3 in. long, which cost 2*d*. per dozen, while for the thicker timbers and in models where nails 1 in. or longer are used it is advisable to use the finest workman's bradawl, the blade of which has been ground to a sharp needle-point; *a light hammer*, weighing about 4 ounces, which can be bought at penny bazaars; *files*, which are very cheap; *cutting pliers*, for cutting off the heads of nails (thus producing wire dowels) and for drawing out any bent nails. More will be said about these tools in the course of the article.

The Right Conditions for Beginners.—(*a*) *Ease in Work.*—It is most important that the wood should, in all respects, except as to correct length, be supplied to the beginner in a condition completely ready for making up into articles. The work of sawing and planing, which generally takes up much time in the woodwork exercises of the upper standards, requires too much skill and too much strength for very young children; and even with older and stronger pupils the work is too laborious, and may dull, if not destroy, the learner's interest.

To demand the above conditions is only to ask that the sound old educational maxims "from the easy to the difficult" and "from the simple to the complex" should be fulfilled. "One thing at a time" is the essence of easy, sure, and rapid progress.

(*b*) *Desire and Interest.*—The first thing to do is to arouse a real desire in the learner to make a certain article. There is hardly

ever any need to excite a desire "to make," for that is, ordinarily, inborn and ever active.

It is the securing of the child's selection of a certain object because of its educational possibilities that is the teacher's task. The great motive elements in choice, both with young and with old, are *use* and *possession*. We all want what is of use to us, and all the more so if it may become our own. This does not omit the element of interest, for unless we are interested in the use to which we can put a thing, we shall have little, if any, desire to possess it. Given that we want to use and possess a thing, we are generally prepared to work for it.

(*c*) *Fitness for Children.*—As a rule our interest in the use of things is determined by our own nature and the actual conditions of our life and surroundings. We must, therefore, carefully consider the nature and immediate surroundings of the children we are teaching to find the right clue to their likings and desires. We can hardly go very far wrong if we assume that our pupils will be interested in things of use to them—not necessarily to their parents and teachers—in their home and school life.

The next matter to consider, from the educational point of view, is: which of such objects are, in their making, most within the capacities of the little learners, while affording a good starting-point for further development. To satisfy this condition the production of these selected models must involve few and simple operations, and it must be possible to make them fairly quickly, for young children are likely to lose interest and heart if the realisation of their desires is long delayed.

FIRST STAGE.—**Easy One-piece Models.**—By using only one piece of wood, and employing a few of the simplest tool operations, the model is sooner finished. Thus we satisfy the beginner's need for simplicity, reasonable ease, and not too long delayed realisation; whilst at the same time giving real insight, training, and mastery.

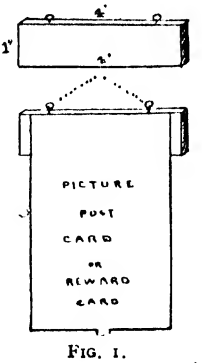


FIG. 1.

A Hanger (Fig. 1) or single short rectangular piece of lath.—This might be introduced by a talk about a small picture, which has been

conveniently glued or pasted by its upper edge to such a simple hanger as the children may be asked to make. A picture post-card, or a school reward card of about the same size, having as its subject something of real interest to the children, would be suitable. It would need to be reasonably cheap—but must on no account be artistically bad—if, as is desirable, one is to be given to each child.

Investigation and Imitation.—Having had the talk, the teacher should ask the children if they would like to have such a picture to hang up, say, in their bedrooms at home. The answer will probably be "Yes," and then the question may be put, "Would you like to have one of these" (showing a packet of pictures) "and fasten them on a hanger for yourselves?" Very well, let us find out how it is done.

This must be worked out by the children from the inspection of the model. Next the teacher says, "Watch me while I make one"; and then proceeds to make one, using exactly the same tools as the children will do, and going through all the operations, step by step, which the children are expected to perform. Care must be taken that every child is able to see clearly each act of the teacher. If necessary, sections of the class should be taken in turn.

The next step might well be to let one of the brightest and handiest of the pupils try to imitate the teacher's work, whilst the others watch and criticise—under the challenge, if necessary, and guidance of the teacher.

Following this, the necessary tools and materials should be given out, and all the children set to work, under the teacher's close supervision. The children should be told to watch, and appeal to, each other if they are in difficulties, or ask teacher. This will be likely to give confidence. Later on they may be told to try to make a given model without help of any kind until they have finished their attempt. This should give them self-confidence. During the initial steps the teacher must keep a very keen look-out for any one who may be making a bad or dangerous mistake.

Those who succeed in making a presentable job of their first efforts might be allowed to become the owners of their models,

and take them home for hanging in their bedrooms. Others should be told that they will have another chance. This taking home of objects made at school is not only encouraging to the children, but may also encourage parents to take a keener and more sympathetic interest in the school, thus linking up home and school life in a very practical and real way.

Before discussing other models we will, for the sake of teachers inexperienced in such work, describe some of the most important tools used at the beginning of the work.

The Saw.—This is the most important of the seven (only) tools needed for the first-stage models. It needs no detailed description, and it is only necessary to say that it is a small tenon saw with a blade about 5 or 6 in. long. It is much better to have those which are made with the ordinary shaped handle, which reduces the difficulties of control to a minimum, and raises the efficiency to a maximum. Those made with the plain grip demand much undue and misdirected energy for control and work. Two points need attention in working the saw—viz. the blade must be held perpendicularly, moved horizontally, and lightly rubbed backwards and forwards in the required direction.

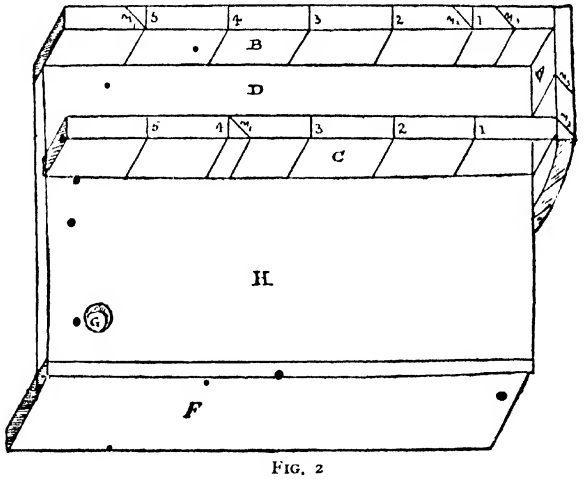


FIG. 2

The Saw Block (Fig. 2).—This is an important tool in the initial stages, and is therefore fully described.

This tool is to be used with the child's small saw, and is indispensable for infants and those in the lower standards who are just commencing practical woodwork. The child's saw block is an improved bench hook, upon which the child lays his lath or rod whilst he saws off any required measured length. The base, H, is a piece of hardwood, which is about 8 in. square and about $\frac{1}{2}$ in. in thickness. B is a strip of hardwood, at least $1\frac{1}{2}$ in. wide, $\frac{5}{8}$ in. thick, and as long as the base H is wide. B is securely fastened along the upper edge of H and stands about $\frac{1}{2}$ in. (or more if thought necessary) higher than the upper surface of H as shown in the figure. F is a similar piece—but slightly wider and made of deal—fastened along the lower or near edge of H and hangs a full inch lower than the under surface of H, so as to catch against the front edge of the desk or work bench upon which the child is at work.

At the distance of an inch (or the width of the wood which has to be sawn upon the block) from B, a groove is made across the upper surface of the base H. The groove is recommended to be about $\frac{1}{2}$ in. wide and $\frac{3}{16}$ in. deep. Into this groove a strip of hardwood (C), 1 in. wide and $\frac{1}{2}$ in. thick, is securely glued or otherwise suitably fastened (if nailed, no nails must appear in the guide saw cuts) from the underside. Thus between B and C there is formed a groove (D) exactly as wide as the laths or rods are which have to be sawn upon this block. At the right-hand end of the groove D a stop A is fastened along the side of the base H. Against this stop A the child places the end of his timber when he is sawing off any required portion.

Uses of the Saw Block.—The portion of the base marked E forms a small work-table upon which the child: (*a*) places his sandpaper in a flat position whilst he gently rubs the sawn ends of his timbers—once or twice only—upon it; (*b*) arranges his pieces of timber to see how they fit, and builds them together when they are made accurately—so constructing his models.

The hole G is used (an empty cotton reel, however, is oftentimes more convenient) when it is required to drive nails right through any piece of wood—so as to project prominently on the other side—before arranging it in its correct position on another piece.

At regular and exact intervals (inches or intervals equal to the

width of the wood to be used) through the two strips B and C, saw cuts are made, into which the child may place his saw when he is sawing off any piece of wood which he may require for the model he is making.

Also, across the right-hand end of the groove a carefully sawn mitre cut (M_2) is made so that the child can mitre and point any piece of lath or rod when required. When pointing a lath—*e.g.* to make a model of a common paling—the child may select one of two methods:

(1) Place the lath flat in the groove, with its end close against the stop (A), then make a mitre cut across the end, that is, saw a waste corner off along the diagonal of the end square; then simply turn (or roll) the lath over and see that the point just made is close against the stop (A); place the saw in the same guide saw-cut (M_2) as before, and saw off the corner, leaving the lath pointed exactly in the middle.

In this manner a child produces a model of a common pointed paling, and one or two careful rubs on the flat sandpaper will finish up neatly the otherwise rough edges left by the saw. This first method, however, although it is the easier of the two, reduces the original length of the lath by half an inch. The palings thus obtained form a useful variety to mix with those made by the second method, when constructing toy gates or lengths of model fencings for various purposes.

(2) Place the lath flat in the groove as before, but so that its end is $\frac{1}{2}$ in. away from the stop (A); now place the saw in the mitre-cut guide and carefully saw off one small corner; next turn the lath over as before and carefully saw off the other small corner, and thus leave the lath pointed exactly in the middle, while retaining its full original length.

Another mitre-cut guide (M_1), made in the middle of the groove (D), enables the child to mitre cut his short pieces of timber in the centre or in any other desired point. On other saw blocks, in place of the 45° mitre-cut guide being made, another saw-cut guide of 30° or 60° or some other required angle may be made by the teacher, so that varieties of units for making parquetry or other over-lay patterns may be prepared.

Care of the Saw Block.—One or two hints may be here given, by

which the life of a saw block may be lengthened. (*a*) If the strips (B and C) are made just as high above the base of the groove (D) as the width of the saw blade, it will be impossible for the child to damage the base of his saw block when he has sawn through the timber, since the brass back of his saw would then ride upon the top of the strips (B and C), and thus prevent the child from sawing beyond the thickness of his timber. (*b*) If the child places a strip of paper or thin cardboard in the groove under his wood, before he begins to saw it, the paper or cardboard will soon indicate to him when the timber is sawn through, and thus, in some measure, prevent him from damaging the surface of the saw block.

Measuring.—If the little learners have not already learned to use the rule for measuring, they may now be introduced to such work. The hanger in the model—which should be exactly 4 or 5 in. long should be measured, and then an equal distance should be measured and marked off along the edge of the piece of lath (15 to 18 in. long) which is given out to each child. Only a dot on the upper side of the lath is required at this stage, as squaring with the T-square will come later. The measuring is superfluous, except as training and practice for the learner, since one of the saw cuts on the saw block would give the required point; but the training is very valuable, and the saw block can be used as a test of the measuring.

Smoothing the Sawn End.—Both ends of the given lath should be already trued, at this stage, so that the child has as few things as possible to do. To smooth up the newly sawn end is the first introduction to workmanship. The method of procedure will have already been demonstrated by the teacher, but the lesson may have to be repeated, either to individuals or groups, as occasion requires, since some of the children are likely to have forgotten it. Holding the wood perpendicularly, and rubbing the sawn end carefully (two or three times only), must be secured.

Pasting or Gluing.—It is assumed that the children are familiar with the simple operation from previous training in paper work. If they are not, a second demonstration will probably suffice for their instruction.

Putting in Screw Eyes.—For the first model this had better be done by the teacher, except that the last few turns of the

screw should be left to the child, who should be required to watch carefully the teacher's actions. If a single screw eye is used, it must be in the centre of the hanger; if two screws are used, they must be equidistant from the ends.

Some Other Models.—At first only longer pieces of wood, about 6 to 12 in., should be used. It must be remembered that the handling of small pieces requires greater skill and control, and should therefore not be attempted until some training has been given and power acquired. When these longer pieces are reasonably well manipulated, the size can be gradually reduced. The sketches in Fig. 3 will suggest to the teacher all that need be indicated here, as to possible easy rectangular flat models and their uses.

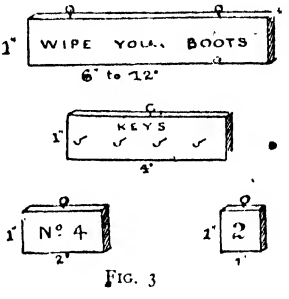


FIG. 3

First Use of the Bradawl.—When some progress has been made, and confidence gained in preparing a piece of wood—the first two models should be sufficient for this—the pupil should use the bradawl himself, make the holes for the screw eyes (or cup hooks) and screw them in. The principal points to be observed in using the bradawl are: See that the wood lies flat upon the bench; hold the bradawl perpendicularly; place the point exactly on the mark (a dot at a previously measured distance) for the hole; push it in to such a depth that it will stand upright without being held; and then test its perpendicularity. This testing of perpendicularity is done by slowly turning the piece of wood round, whilst it still lies flat upon the bench, and seeing that the bradawl stands perpendicularly whichever side or end of the wood is in front. The value of the test is that it helps to secure a perpendicular hole, which is so important for the right position of the nail, cup hook, screw eye, etc. Of course when preparing holes for the screw eyes in the upper edge of the lath the wood must of necessity stand upon its edge, and not be laid flat down, whilst being bored and tested.

If a skewer be used as a bradawl and more power is required in handling it, this can be obtained by passing a pencil or piece

of round wood through the ring at the top, and using it as a handle.

First Use of the T-Square.—The first use of the T-square may be made in connection with the use of the bradawl. When the distance of the point for the hole from the end has been measured and marked, a line should be squared across the breadth of the lath, and the middle of this line then found by means of the rule, so that the hole for nail, cup hook, etc., will be exactly in the centre of the breadth of the lath. Suitable T-squares can be made by the elder pupils.

Sawing without the Saw Block.—It is a sound rule in education that anything in the nature of what may be called a crutch should be discarded at the earliest moment at which this can be safely done. So soon, therefore, as bright pupils show good handling of the saw in the saw block they should be allowed to try right-angle sawing with an ordinary bench hook. The teacher should demonstrate to the pupils before they attempt such work. Squaring the line of sawing on at least two contiguous sides of the wood should be done for such sawing, whenever the thickness of the timber is sufficient for the purpose.

A Games Model—Dominoes (Fig. 4).—The play interest, being one of the keenest and most vital in child life, should be utilised to the fullest possible extent. If the children do not already know how to play with dominoes, they should be taught some simple game with them—a game let it be noted, not number lessons (though these are necessarily involved in the game, and in some of their most attractive and efficient forms). The suggestion, to the children, that they should make a set of dominoes for themselves will doubtless be eagerly accepted. The set might be made by and become the common property of a group, to be used by them at certain times and under certain rules. This would introduce a simple form of group (club, gang, society) life, and a captain might be elected by the group.

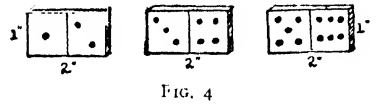


FIG. 4

The best size for a domino is 2 in. by 1 in. by $\frac{1}{4}$ in. The middle line of the domino should be drawn with pen and ink—thus

teaching the use of the bevel side of the ordinary school rule—and the dots marked with a school colour-brush and ink. The children should, as a result of their training in brushwork, be able to put in the dots with sufficient accuracy freehand, according to the models supplied by real dominoes, or on paper slips. Each child might do a distinct section of the set: thus one child would do the blanks—double blank, blank-one, blank-two, etc., to blank-six; another child would do the ones—double one, one-two, one-three, etc., to one-six, and so on to six-six. The dominoes could be kept in boxes or cloth bags made by the older boys and girls.

Models made of one flat piece of wood and having one or both ends easily shaped. These produce useful articles, *e.g.* rules, hangers, palings, tags, labels, etc.; and give training in mitre-cut sawing and sandpapering. Fig. 5 will give most of the information needed.

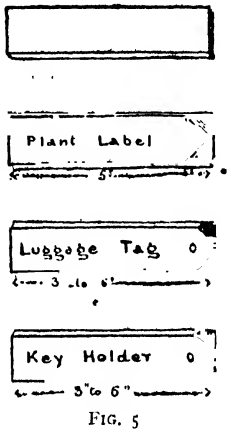


FIG. 5

The measuring, marking, and shaping for working purposes all give good training for more advanced work, while the connection of the models with gardening and other needs of ordinary life arouse and sustain interest. Such shaping of the ends can, of course, be used for simple decorative finish in many other models.

The simple rectangular pieces of lath when first cut may become short rules, with or without small subdivisions; when the ends are shaped, as shown, they become samples of palings; and these again, when pierced, become tie-on tags or labels for keys, luggage, or trees, etc., in the garden.

The way of holding the wood and working it on the sandpaper, to procure a rounded end, must be carefully demonstrated by the teacher, the children carefully watching the process and afterwards describing it.

The curved end of the key holder may be drawn in one of three ways: (1) by a template of cardboard, wood, or metal, (2) freehand, or (3) with compasses, according to the ability and skill of the individual pupil. As much as possible of the waste should be cut away with the saw (as in the luggage tag), and then the re-

maining angles rounded off as required on sandpaper. The holes in these models might be made by carefully boring half-way through from each side with a fine bradawl, and then following in a similar manner with a large bradawl; or boys eight and nine years of age might try their hand with a small-sized brace and pin bit.

The Beginnings of Design.—The simple modification of the ends, for decorative purposes, may be made the germ of invention and design. The children should be asked to suggest different forms, which might be sketched on the blackboard by them, and also by the teacher, so that the best impression should be received by all. Then these sketches should be rubbed out and each child told to shape his own end in his own way. A glance at the illustration opposite p. 198, Vol. II., will show what is likely to be the result of this. Liberty for these early efforts at design should be constantly given, especially to the brighter pupils.

SECOND STAGE.—**Easy Two-pieces Models.**—When a model consists of two pieces of wood, the art of construction is begun, and more confidence, skill, and knack are needed than for a one-piece model. Such models introduce the element of joining, which is important and requires the use of some new tools—*viz.* nails and hammer. Otherwise there is nothing new in this stage as far as beginners are concerned. The difficulty of a model, however, does not consist solely of the number of pieces of which it is composed, nor, at this early stage, of the kind of joint by which these two pieces are connected; but to these young beginners the difficulty arises from the relative position that one of the pieces must bear to the other.

Position One.—Both pieces *lying flat down*, one upon the other. (*a*) Both in the *same direction* of fibre or parallel to each other. This includes these cases: (1) one may exactly cover the other so that the edges and ends are all level (or register); (2) the sides of the two pieces may register, but the end of one may overhang the end of the other, and thus form an end tongue or tenon; (3) the ends of the two pieces may register, but the side of one may overhang that of the other, and thus form an edge tongue as in flooring boards. If a third layer of lath be added on the top of the other two, models of two shouldered tenons, open and closed mortises, bridle joints, etc., can be formed.

(*b*) One at *right angles* to the other, and thus form primitive models of (1) Try Square (letter L); (2) Tee Square (letter T); (3) Roman Cross (†); or (4) a cross with equal arms (+), etc.

(*c*) One piece may be laid flat upon the other, and a single nail driven temporarily through both in some particular point. One will now revolve upon the other until some *required angle* is obtained, when both can be permanently nailed together.

In any of the above positions the block thus formed may become an important integral portion of some other more complex model.

Position Two.—One piece may lie flat down and the other one may stand on its edge upon it: (*a*) in the *same direction of grain*, and thus form a model of a pipe rack or shelf; or (*b*) one may cross the other at right angles and form a bracket shelf with a long upright back.

Nails and Nailing.—*The nails* used are made of very fine wire, and have flat, round, raised, or very small heads—the last named being known as panel pins. They all have very fine sharp points, so that they do not split the thin wood when being driven into it. The wire commonly used for such nails is 17 gauge, but a finer gauge (21) is better, and a few pounds weight of such should always be kept in store. A thicker gauge than 17 is not suitable, since it splits the wood and so discourages the children. The nails vary in length from a quarter of an inch to two inches, increasing by eighths of an inch. If the heads of the longer nails are cut off, by means of the cutting pliers, they form good *dowels* for many useful connections in light woodwork, especially so when using square rods.

When a model is composed of two flat laths lying *flat* one upon the other the total thickness of timber does not exceed half an inch; and since it is essential to good-looking work that no nail points should project or be bent over, in this kind of models nails not exceeding half an inch may be used. But whenever possible in the earliest exercises, especially when driving nails *in* the edges and ends, no nails less than $\frac{3}{4}$ in. long should be used, since smaller ones are more difficult to handle and to hammer. This is an example of the principle that small or large objects—in comparison with the size of the hands and fingers—need more or less of trained skill for easy and successful manipulation.

Holing is an important factor in woodwork, for, no matter how accurately and neatly the separate pieces of wood are prepared, the completed model will be out of square and unsightly to the eye if the nails be not well arranged and correctly driven into the wood. The following rules should be carefully observed during the early exercises, and until skill and mastery are obtained. (*a*) Accurately mark, with dots, the exact places where the nails are to enter the wood, and also where they are to come out on the other side in case they go right through the wood. In cases where two or more nails occur in a row, the spaces between them should be accurately measured out. When two parallel rows of nails occur on the surface of any model, the nails should form pairs and be level with each other.

(*b*) With the fine needle-pointed bradawl make each hole right through one piece of wood—if necessary, as in square rod work, first boring half-way through from each side of the wood, according to the prepared marks, and then withdrawing the bradawl, and pushing it a sufficient depth in corresponding places in the second piece.

(*c*) Place a nail of suitable length perpendicularly in each hole in the first piece of wood; take the fingers away from it; and then gently tap each nail, using a cotton reel for an anvil during the operation, till the point just shows through on the other side.

(*d*) Place the first piece of wood upon the second, so that the nail points just fit into their respective holes.

(*e*) Gently tap the two extreme nails a short distance into the second piece of wood, so as to hold the first piece of wood in its correct position, and then proceed to hammer all the nails fully into the second piece of wood. The use of glue to strengthen the joining will be dealt with later.

Use of the Cotton Reel as an Anvil.—"Drive the nail aright, boys; hit it on the head," is a very easy thing to say, but a much more difficult matter to do. In the ordinary run of every-day life, when people are driving nails into walls, etc., they pay little attention, as a rule, to where the point is going, so long as the head remains in its correct place. But in the practical education of our little workmen we wish them to grasp the importance of direction, and to learn how to drive a nail in such a manner that

the point maintains its correct direction, and, after making its journey through a piece of wood, reappears upon the other side in the exact spot where it would have to appear. When this skill is attained, there will be a minimum danger of any nail point coming to view in some wrong place, and thus giving an unsightly appearance to the model.

To gain this most desirable skill an empty cotton reel is used as an anvil upon which the child holds his piece of wood—through which he is driving a nail—in such a position that when the point comes through the wood; the nail makes its passage down the hole in the middle of the reel. As soon as the point has been driven through to a required amount, the child can lift up his wood and examine—and if need be correct—the direction of the nail before fixing the two pieces of wood together.

The cotton reel is a very important adjunct in dowel work—when a dowel projects equally on each side of a central piece of wood; when an additional piece of wood needs to be added to each side of a central piece.

The Hammering should be done with the hammer held with the hand well back from the head, and each blow struck so that the flat face of the hammer falls flat upon the head of the nail. A few gentle taps should suffice to drive the small nails fully home. Heavy blows will be likely to bend the nails and spoil the work. Should a nail be bent, it ought invariably to be withdrawn, in the interests of good workmanship and appearance. In no case should these small nails be held with the fingers during the process of hammering. The holes for the nails should be made just large enough to allow them to stand perfectly upright in them without being held.

When a row of two or more nails is required in the same piece of wood, it is well to drive them all in a little way first and then test their perpendicularity, as with the bradawl when boring holes, before proceeding farther. From the front view the nails should all appear upright and parallel with each other, and from the end view they should fall in line one behind another so that the nearest nail only is seen standing straight up. As before stated, whenever possible nails should be placed at regular intervals in the same straight line, and if two rows of nails show on the same

surface of a model, they should lie exactly opposite each other, *i.e.* agree or register, as it is called.

A Simple Bracket (Fig. 6).—This can be used as a stand for small ornaments, etc. It is made from pieces of lath 2 in. wide by $\frac{1}{4}$ in. thick. One piece (B) is 3 in. long, and the other (A) 2 in. Each piece is prepared as in Stage I., and the ends may be rectangular or shaped as in Fig. 5. Two or three nails will be sufficient, and the nailing should be done as already described. Fig. 6 will explain the procedure. The position of the nails is determined thus: Mark off at the end of the 3-in. piece a space equal to the thickness, *i.e.* $\frac{1}{4}$ in., and along the centre line of this space place the dots to indicate the nail holes, thus dividing the thickness of the wood into equal parts; or the second piece of wood can be arranged in its position on the first piece and a pencil mark traced along the inner side. One or two screw eyes will be required to complete the model.

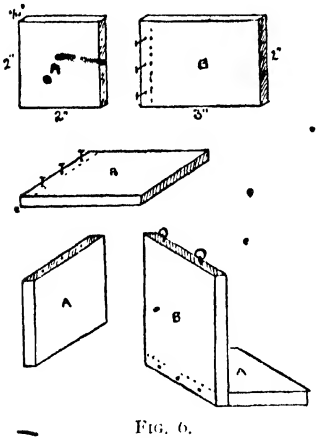


FIG. 6.

The Use of Glue.—Glue is used to strengthen a joining, and also to prevent revolving when one piece of wood is attached to another by one nail. It is put on after driving the nail or nails through the first piece, and just before beginning to drive them into the second. The task of gluing is very simple, but great care is required to make a good joint. The general rule is that the layer of glue shall be so thin that the seam will scarcely be seen. The glue must not be too thick or too thin, and it must be perfectly free from shavings, sawdust, etc. As small a quantity of this glue as possible is touched, evenly and quickly, along both sides of the joint with a small brushwork brush; and the two pieces are then arranged in position and the nailing completed.

The Principle of Discovery.—The ordinarily intelligent child dearly loves to find out things for himself. This inclination should be zealously and systematically nourished and cherished by the teacher, for it is the germ of the spirit of scientific inquiry, and

the very source and origin of invention and originality. It has already been suggested in the paragraph on "Investigation and Imitation," and can now be given a more direct and systematic stimulus. When the introductory talk on brackets, their uses and forms, has aroused interest and led to a desire to have and make one, the teacher should offer to the children such a one as is suitable to make, so that they may discover for themselves how to make it. A challenge for suggestions will probably produce the reply, "Pull it to pieces." The bracket should have been lightly put together, so that this is easily done, and a bright pupil should be allowed to come to the front and actually do the pulling to pieces, while the others watch and criticise under the teacher's guidance and control.

When the model is in parts, observation and description by the children ought to give all the details of construction. These should be sketched and described on the blackboard by the teacher. It is good preliminary training in drawing out plans and specifications. Next, the measurements should be made by different pupils, and recorded by the teacher on the blackboard. The wise teacher will see how many beginnings of higher things are involved in such work, and every teacher will find a rich reward in the keenness and progress of his pupils.

One of the best means of gradually developing the highest powers of each learner is to have a great many varieties of models, and as far as possible to give a different one to each of the pupils who are ready for individual work (after class demonstrations), and leave them to find out for themselves (without pulling the model to pieces) how to make it. Of course they should go to the teacher for advice and guidance when they are unable to solve a difficulty.

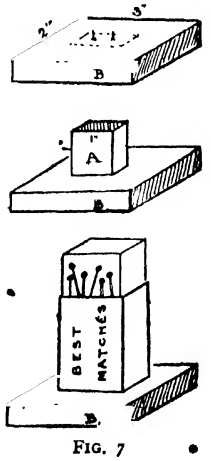


FIG. 7

A Match-box Stand (Fig. 7).—This is a convenient thing to have in a house and would be likely to interest the pupils at this point of their progress. The making of the model is more complex with regard to the exact fitting of the parts. It is made of

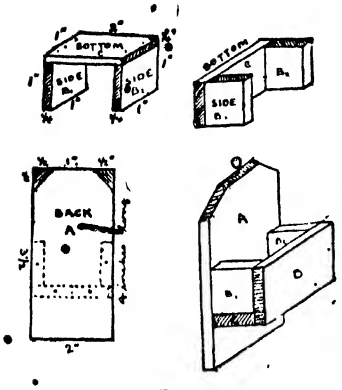


FIG. 8

two pieces of wood, one (B) 3 in. by 2 in. by $\frac{1}{2}$ in., and one (A) 1 in. by 1 in. by $\frac{1}{2}$ in. for an ordinary small-size match-box. Fig. 7 sufficiently explains the exercise, the other details of working being as before.

A Wall Pocket (Fig. 8).—This has many practical uses both for the house and the school. The skill required in handling while doing the nailing is an advance on what has gone before, and larger sized wood is introduced. The wood required is: one piece (A) 4 in. by 2 in. by $\frac{1}{4}$ in. for the back; two pieces (B_1, B_2) 1 in. by 1 in. by $\frac{1}{4}$ in. for the sides; one piece (C) 2 in. by 1 in. by $\frac{1}{4}$ in. for the bottom; and one piece (D) 2 in. by $1\frac{1}{4}$ in. by $\frac{1}{4}$ in. for the front. First the sides should be nailed and glued to the bottom; then these held against the back whilst their correct position is traced by a pencil; next nail holes are made in the back, boring from the front (to make certain that the nails shall come through at the right spot). Insert a nail in each hole (from the back) and gently tap in till the points just appear on the other side. Add glue where the pieces will touch. Place the back correctly on the top of the sides and bottom, and drive in the nails. Finally fasten on the front. Fig. 8 shows the method of procedure.

Care must be taken that the sawn edges of B_1, B do not appear on the upper

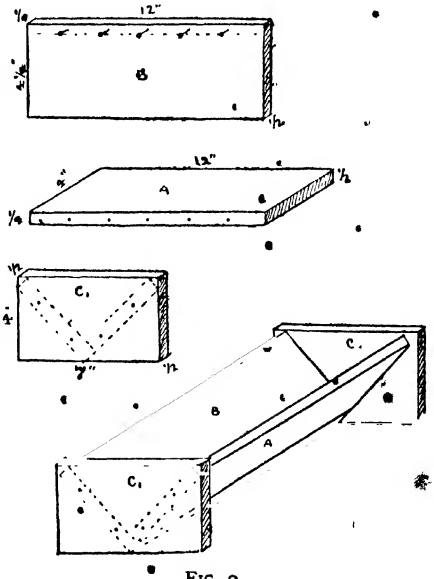


FIG. 9

edge of the pocket; and the grain of the wood of B_1, D, B_2 must run in the same direction round the pocket.

A Book Rest (Fig. 9) or a V-shaped feeding trough.—When the pupils have got facility and skill in handling fairly large pieces of wood (see "Other Models," below), they might tackle a small book rest to hold their own books (if any) at home. To form the sides, one piece of wood must be as wide as the other plus the thickness of the wood. For the suggested model one piece of wood (A) 12 in. by 4 in. by $\frac{1}{2}$ in. and one piece (B) 12 in. by $4\frac{1}{2}$ in. by $\frac{1}{2}$ in. will be required for the sides, and two pieces (C_1, C_2) each 7 in. by 4 in. by $\frac{1}{2}$ in. for the two ends.

Fig. 9 indicates the working: first arrange A and B to form a V-shaped gutter; stand this gutter up on its end on C_1, C_2, and mark out its shape (see dotted lines on C_1); between the lines thus marked make the required nail holes; use $1\frac{1}{2}$-in. fine wire nails, and drive them perpendicularly until the points show through, using the cotton reel as an anvil; add glue in places where required; adjust the pieces carefully together and nail; test the accuracy of the work after each nail has been driven in.

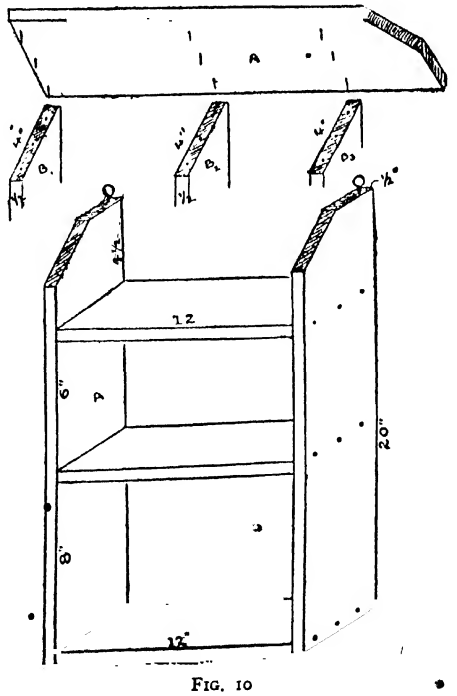


FIG. 10

A Small Book Shelf (Fig. 10).—The bigger and more skilful pupils might even try a small bookshelf. Two pieces of wood (A) are required for the sides, and one of the upper corners is shaped off as shown. The lowest row of nails must be at least a full quarter of an inch from the end of the wood; to give room for 8-in. books

on the lowest shelf the next row of nails must be 8½ in. away; and the topmost row another 6½ in. to allow room for 6-in. books on the middle shelf. Prepare the nail holes as shown; insert 1¼-in. nails and drive them in. Take care that the two sides form a pair, *i.e.* that the nail points in one point to those in the other. Prepare the three shelves; arrange; glue; and fix up the model as shown in Fig. 10.

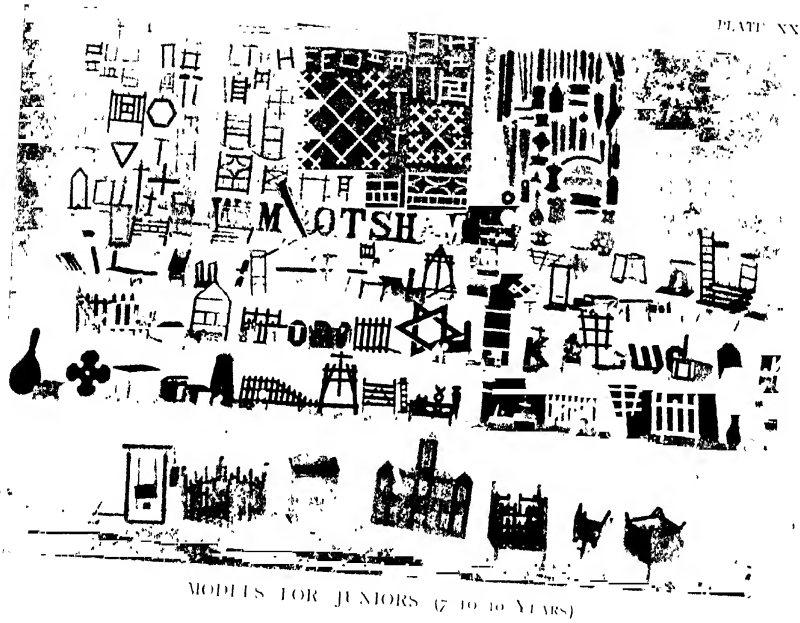
Some Other Models.—A great many varieties (size and shape) of moulds for sandwork, simple boxes, brackets, book rests, book shelves, corner shelves, wall pockets, troughs for birds' or rabbits' food, etc., etc., may be made as examples of purely flat lath work; whilst various examples of palings, being fastened to more substantial square rods to form types of fencing, gates, etc., can now in turn be further converted into sheep folds, which may be used as pretty and ornamental fern baskets, etc., by fastening four of such simple models together to four upright square rods as corner posts.

The frame work of outbuildings is also copied in square rod work; posts, rails, wall plate, spars, rafters, ridge plate, etc., are represented, and these are in turn covered over with flat laths after the manner of common boarding. Towel horses, chairs, tables, swings, etc., are also in a similar way reproduced.

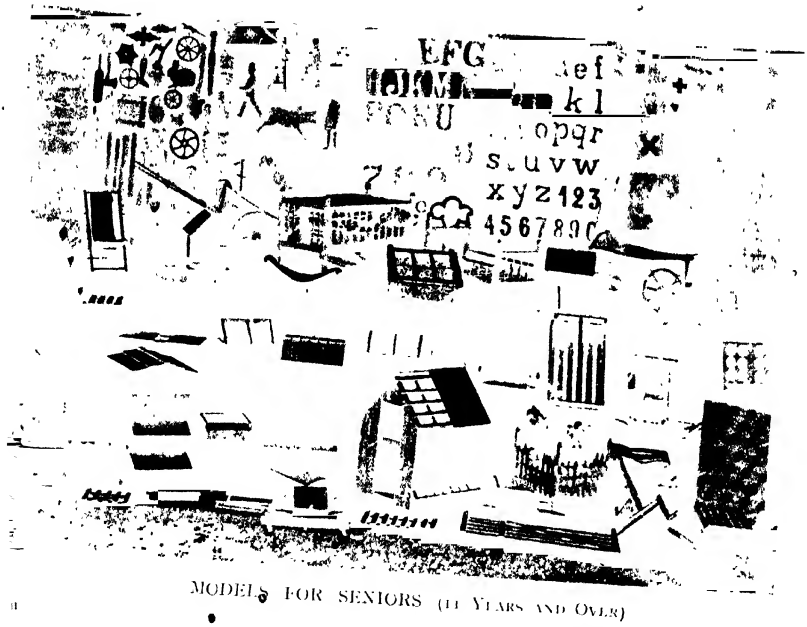
The children should be invited to suggest possible models; to bring from their homes examples to be copied; and to find out others by observation. Teachers should exercise their own ingenuity and invention also. It is this kind of effort which reaches the deepest points of interest and true educational development.

Miniature Models.—While as many as possible of the earlier models should be for practical personal use and of ordinary commercial sizes, there is a place and purpose for miniature models. First, they are useful as toys for the children's games of pretence, and secondly they are valuable for teaching the construction of articles which, in full size, are beyond the children's powers. Such models form an excellent preparation for later work, but they should be comparatively few in number, and should make some real appeal to childish interests.

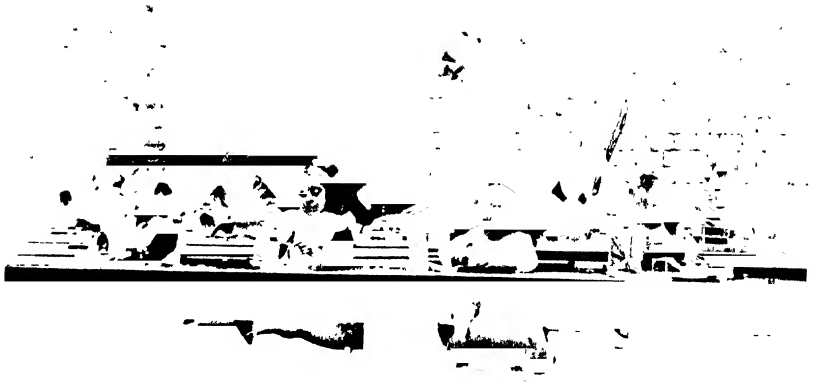
THIRD STAGE.—**More Difficult Models.**—All the substantial



MODELS FOR JUNIORS (7 TO 10 YEARS)

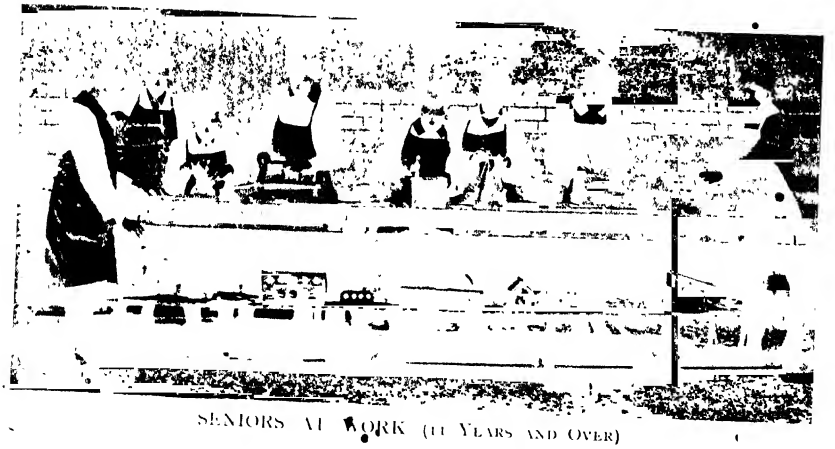


MODELS FOR SENIORS (11 YEARS AND OVER)



INFANTS AT WORK (UNDER 7 YEARS OLD)

JUNIORS AT WORK (7 TO 10 YEARS OLD)



SENIORS AT WORK (11 YEARS AND OVER)

elements needed for beginners are included in Stages I. and II., and all that is now necessary is to indicate the directions in which these may be developed. It must be remembered that small and fine work is more difficult for beginners than larger and rougher work. If, therefore, they now undertake models which have more details, greater complexity of structure, and require smaller and finer work, requiring some fresh tools, these elements will secure a higher development of skill and judgment. The number of pieces or parts is not likely to present much difficulty. The work now to be described is such as could be done by the strongest and cleverest children in infants' schools, or by the older and stronger beginners in the lowest classes of elementary and secondary schools.

A Parcel Carrier (Fig. 11).—Children who are household messengers will appreciate the practical advantages of a parcel carrier. It is easy to make and introduces the use of the file. Any kind of wood may be used, *e.g.* deal, bass, beech, oak, etc., which should be supplied to the pupils in "rounds" of suitable diameter. Fig. 11 indicates the working. The suggested model is prepared from 4 in. of $\frac{3}{4}$-in. round rod. The ends are rounded by rubbing on sandpaper; the middle notch is made by the sharp edge of a half round or triangular file.

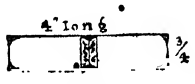


FIG. 11

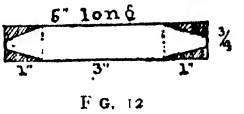


FIG. 12

Tipcat or Beggy (Fig. 12).—This appeals to the play instinct in children. It is made from "rounds." The round used is of the diameter needed for the finished model, and is made by the aid of file and sandpaper. Fig. 12 gives the details. The points are made, in the first place, by careful use of a rough file, followed by a finer one. The model is made from 5 in. of $\frac{3}{4}$-in. round rod, the points being each 1 in. long.

The Uses of Files.—The correct holding and working of a file should be demonstrated by the teacher. *Flat and half-round files* are used for shaping (or modelling) the ends of many pieces of timber; filing off the points of nails which project through the

wood ; and for finishing grooves, open and closed mortises, as well as their corresponding tenons. *The sharp edges of half-round and triangular files* are used for producing the notches which are required in the wooden layering pins used by gardeners for carnations, etc., and in models such as deck chairs, etc. *Round files* finish off round holes, and also slightly enlarge them when required. *Square files* are used in the centre of wheels to produce square holes, into which the necessary axles have to be fitted.

A Child's Buzzer (Fig. 13).—This is made from a piece of wood 3 in. square and ¼ in. thick, and introduces the use of the brace with a small-sized pin bit. Rule the diagonal ; find its centre ; and, ½ in. on each side of the centre, bore a small string hole, as shown in Fig. 13. Thread 2 ft. of macramé twine through the holes ; tie the ends ; and show the children how to use the toy.

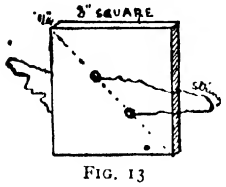


FIG. 13

First Use of Brace and Bit.—The smallest-sized brace, which has a sweep of 5 in., is the most convenient for children's use. Bits are of many patterns, but only a few are required for elementary woodwork : (*a*) *The Pin Bit.* otherwise called a quill bit or shell bit, of the smallest bore, is chiefly used for boring small-sized holes for screws, etc., but more especially when making preparation for using the centre bit. (*b*) *Centre Bits* are used for boring holes of various sizes, suitable for winders of many kinds, egg racks, ink-pot stands, ornamental boring, etc., etc. (*c*) *The Countersink* is used for making shallow conical depressions at the upper end of a screw hole, so that a screw head can sink in the wood and thus become level with the surface. It is also sometimes used to ornament the surface of stands for teapots, flower-pots, pans, etc., etc.

For boring purposes the wood must be laid perfectly flat upon a boring block, or a bench hook, which in its turn is placed upon a form or low stool. As the wood is thin, very little pressure but great care is needed. The brace, with bit inserted, must be held perfectly perpendicular, and, the boring point of the bit being placed in position, the worker should use only a little pressure upon the knob and turn the crank slowly. When using centre

bits, prepare the way by using a small-sized pin bit and then bore half-way through the wood from each side.

The use of the centre bit commences the work of preparing wooden wheels for mechanical models. If a hole, say 1 in. diameter or more, is carefully cut with a brace and centre bit—boring half-way through from each side of the wood—there is a round disc of wood liberated, which will form a wheel for a toy barrow or other mechanical contrivance. If two such discs, but one cut with, say, a 1¼-in. centre bit, be firmly glued together, after the surfaces have been carefully prepared by rubbing on sandpaper, centre exactly over centre, a flanged wheel is made (for toy cranes, trains, etc.) to run along the upturned edge of a lath. If three such discs, a smaller one between two larger ones, are securely glued together in a similar manner, a pulley wheel is made, and this can be used in many mechanical models.

A Fishing-line Winder (Fig. 14).—If the boys are not themselves fond of fishing, they may make a winder to present to a father or brother who is. Otherwise it will be quite useful in garden work, or as a private possession. This model introduces the use of brace and bit for getting concave ends. After the holes have been bored, the waste ends are sawn off through the centre of the holes.

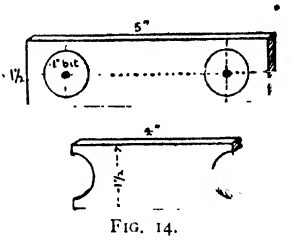


FIG. 14.

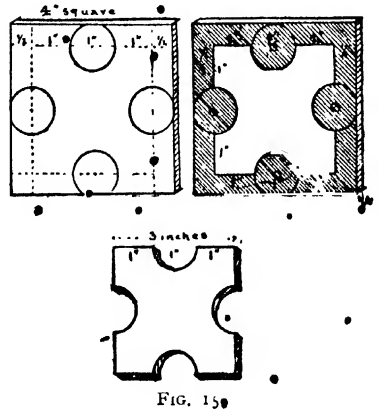


FIG. 15.

The suggested model is 4 in. long when finished, but requires a piece of wood 5 in. long, 1½ in. wide, and ¼ in. thick. Plan the work out as shown; bore the small pin-bit hole first, to prepare the way for the centre bit.

Another Winder (Fig. 15).—This requires a piece of wood 4 in. square and ¼ in. thick. Plan the work out as shown; use a small pin bit as before, to prepare the way for the 1-in.

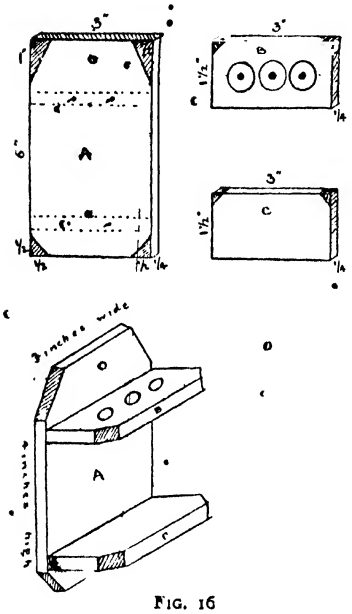


FIG. 16

centre bit; bore half-way through from each side; carefully saw off the waste (see shaded portion); and finish up neatly.

A Pipe Rack (Fig. 16).—This model requires wood 3 in. wide and $\frac{1}{4}$ in. thick. The back (A) is 6 in. long with its corners shaped off as shown. Line *a* is $\frac{3}{4}$ in. from the lower end of the back, whilst line *b* is $1\frac{1}{4}$ in. from the upper end. The other lines indicate the position that the shelves will occupy. On these lines: prepare nail holes between each pair of lines for $\frac{3}{4}$-in. fine wire nails. The shelves are each $1\frac{1}{2}$ in. deep, and a pair of corners are shaped off each shelf as shown. The upper shelf contains three holes bored as previously stated. A small pin-bit hole is made for hanging up. Arrange and finish up the model as shown in the figure—4 in. between the shelves.

A Stand for Paint Brushes (Fig. 17).—This model requires two pieces of wood (A_1, A_2), each 6 in. long, 2 in. wide, and $\frac{1}{4}$ in. thick, for the shelves, and two pieces (B_1, B_2), each one 2 in. long, 1 in.

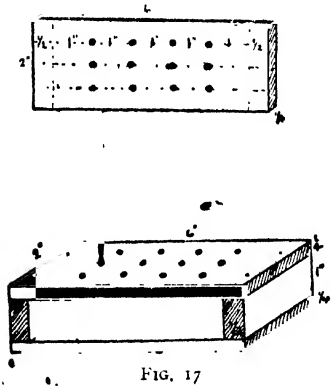


FIG. 17

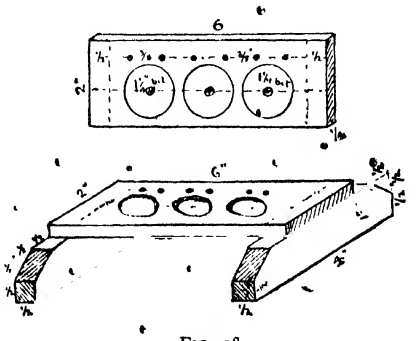


FIG. 18

wide, and ½ in. thick, to separate them. On the upper shelf rule three lines along the surface ¼ in. apart, and allocate four brush places along each line; use a small-sized pin bit and bore the holes. The lower shelf is left plain. Finish up the model as shown, using glue and eight ¾-in. nails.

A Pen and Ink Stand (Fig. 18).—This should prove an acceptable article for the bigger children to have for home use, and some children might be allowed to have them at school. They can be used for keeping inks or paints of various colours, with pens or brushes. One piece of wood 6 in. by 2 in. by ¼ in., two pieces 4 in. by 1 in. by ½ in., and one piece to fit between the supports for the ends of the brushes or pens to rest upon, are required for the construction of the model. Careful planning will be needed to fix the centres for the holes. The smaller holes should be bored first, and then the larger ones. Fig. 18 shows the details.

If the model is made longer, the small holes omitted, and the large 1¼ in. holes bored along the centre of the shelf, a useful egg-rack is produced for use in the pantry.

Some Details about the Timber Used.—(*a*) *Laths.*—For children of five, six, or seven years of age, and for other beginners, common, sawn (not riven) plasterer's laths, which are about 1 in. wide and ¼ in. thick, make excellent material for the basis of a woodwork scheme. These can be obtained from timber merchants and builders, in bundles containing about 500 ft. The laths in a bundle are all of one length, but the lengths of the bundles vary from 2½ to 4½ ft. Timber merchants will, at a small extra charge, saw (*i.e.* rip) the laths into narrower pieces, in equal or unequal portions, so that a bundle may be made into one containing 1,000 ft. ½ by ¼ in., and another bundle into one which contains 500 ft. ¾ by ¼ in. and 500 ft. ¼ by ¼ in. The prime cost of a bundle of 500 ft. by 1 by ¼ in. varies from 1*s.* 3*d.* to 1*s.* 6*d.*, but with the extra sawing (to obtain the 1,000 ft.) the price per bundle of the 1,000 ft. is from 2*s.* to 2*s.* 6*d.* If purchased in a planed condition, the price is further increased, the 500-ft. bundle costs about 3*s.* 9*d.* and the 1,000-ft. bundle about 4*s.* 6*d.*

Larger Pieces.—When larger pieces of wood are required, common deal is the most suitable, at first, and this is cheap and easily obtained in the builders' timber yards, where many varieties of

small sized timbers (commonly used for many purposes in various kinds of building) will be found, both in a planed and unplaned condition. When the pupils have acquired some skill, then better kinds of wood, such as bass-wood or American whitewood, satin walnut, oak, beech, etc., may be used. Such wood will be obtained in boards of various sizes, but must be given to beginners in the exact width and thickness required for the model to be made.

Preparation of Wood for Beginners.—On examination it is found that the laths contained in a bundle are not all of the same exact thickness, and as it is essential for good work and good appearance that a child's model must not be composed of laths of different thickness, they must be assorted. The boys in the upper classes will quickly sort them out and tie them up into smaller bundles containing laths of equal thickness.

To render these laths more suitable for the children to manipulate on the school benches, the elder boys also saw them into shorter lengths of about 13 to 18 in., according to the desk space allowed each child. Boys of ten years of age or over, who are physically strong enough and have learnt to use the smallest English plane, may be called upon to plane these short pieces of lath – one or two shavings only being removed from each broad side. This planing is done upon an elongated bench hook made for the purpose, and placed at the end of a desk or form.

The planing of the edges of the laths presents some difficulty to these young beginners, but it soon becomes quite an easy matter if a *cradle* is prepared to hold these laths upright on one edge whilst the upper one is being planed.

A cradle (Fig. 19) can be made by the teacher in two ways. First, take a piece of ordinary "joint" wood 2 ft. long, 2 in. wide, and 1 in. thick, and plough a groove (as wide as the laths are thick) say ¼ in. wide, and from ¼ in. to ½ in. deep (according to width of the lath which has to stand upright in the groove), all down the middle.

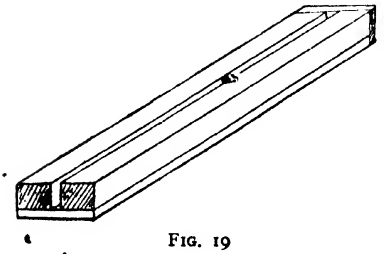


FIG. 19

A stop is made at one end of the groove by nailing or gluing a small piece of wood across the end of the cradle. Second, take a piece of flat deal about 2 ft. long, 2 in. wide, and ½ in. thick. On its upper surface arrange and fix two square rods or similar small strips of wood exactly ¼ in. apart (or as wide apart as the laths are thick) to form a groove along the centre of the cradle. As before, make a stop across one end of the groove.

When a child wishes to plane the edge of a lath, he lays the cradle, like the planing board, upon a form or low bench, places a lath in the groove (which holds it steadily upright on its edge), and then takes off *one or two shavings only* from each of the edges.

As many exercises require that the laths must be an exact inch wide, or ¾ in. or ½ in., etc., it is necessary that, when laths have been prepared, those of the same width must be tied together and kept in store until some particular exercise which requires them is being worked.

Teachers will save much time and trouble in sorting out small timbers if they make use of a "button gauge," *i.e.* a small ordinary rule 3 in. long possessing a brass slide, by which measurements are quickly taken by fortieths of an inch. They cost 1s. 3*d*. each.

BOOKS FOR REFERENCE.

J. H. JUDD: *The "A. L." Light Woodwork* (E. J. Arnold). H. HOLMAN: *Hand and Eye Training* (Pitman). And see various articles on Woodwork in other volumes of this work.

MEMORY DRAWING OF THE OBJECTS OF RECENT LESSONS

the child's love of activity; the muscles have freer play, and hence the reaction on the mental powers is more effective.

Its Psychological Advantages.—Apart from the psychological value of all drawing, free-arm work has special advantages for infants. The rapidity with which effects are produced appeals strongly to the child, whose powers of concentration are undeveloped or rudimentary. As results can be produced so quickly, the drawing is much more likely to have vigour and "movement" than would be possible with a more deliberate and painstaking method. Besides, the natural swing of curves and freedom of line generally tend to develop the artistic appreciation of good form. This method of work, too, results in the production of drawings of rather large size. All teachers know the tendency of the unskilled draughtsman to adopt a small scale in which faults are less apparent; the advantage of the large sketches is therefore obvious.

The Scope of Free-arm Work.—By free-arm drawing in its earlier interpretation was understood the production of large sketches, by arm movements, in outlines more or less conventional in character. But the method has shown itself to be capable of varied applications, including object drawing, mass and outline work, colour work, designing, and to some extent free illustrations.

(1) *Object Drawing.*—Chalk is a very fascinating medium to use; it makes marks so easily, covers surfaces so quickly, is of so many different colours. But although a child finds pleasure in making marks on something, thereby expressing its love of "doing," it finds more pleasure still in being able to make marks that mean some real thing. Hence the teacher's task is to gradually transform the child's scribble into a sketch. Careful selection of objects within the child's power of portrayal, and within his sphere of interest, is of course necessary, and also the suitable placing of these objects to avoid the introduction of too many difficulties at one time.

(2) *Memory Drawing.*—But it must be remembered that the power to draw directly from an object is undeveloped before the age of eight or nine years. The ability to form a clear visual image is, however, very keen in much younger children, possessing,

it has been said, "an intensity equal to that of perception, and in many cases surpassing it" (see Minority Report of Drawing Conference held under L.C.C., 1910). So in early stages the child must be encouraged to form a visual image of an interesting object, aided by judicious questions from the teacher, and then shown how to express the image in drawing. Therefore much of the work is memory drawing, this term being here used in the limited sense that the sketches are made directly after visual impressions have been received. The child unconsciously conventionalises the form, ignoring difficulties of perspective, omitting unattractive details, and recording by his sketch the degree of accuracy of his observations.

It is only a limited number of objects that can be so arranged that every child can see the object and the drawing-board at the same time, and if wall boards are used the number becomes even more limited. This practical difficulty is obviated by a recognition of the above-mentioned principles.

This kind of exercise also permits of the children occasionally drawing things which cannot be brought into the class-room. They are told to notice some particular object on their road to school, *e.g.* a street-lamp, a hayrick, a house, a pillar-box, and after opportunity has been afforded for careful observation, the children attempt their drawings, which are then mutually examined and compared.

(3) *Mass Drawing.*—Now, it must not be forgotten that while the training of the child's faculty of observation is half the battle, the other half is the cultivation of the power to portray its observations. With "infants," perfection of execution is, of course, not to be aimed at, but the teacher must use all means in her power to help the child to see how far his drawing corresponds in form to the original. One great assistance in concentrating a child's attention on shape rather than on contour is to use mass drawing. The form of the object is built up by making a number of lines close together, the "shading" following generally the direction of the outline of the form; *e.g.* a spiral movement produces a ball shape, a number of straight lines a ribbon.

Errors are a great deal more obvious in mass drawings than

in outline. In simple shapes, children usually begin to block in the mass from the centre. Where the contour is more complicated, they frequently endeavour to begin with the outline. In either case, the "shading" makes them look rather at the enclosed space than at the enclosing line, and so is a help to them in analysing form when observing a newly introduced object. Such exercises should be freely interspersed with the drawing of forms which require to be represented only in outline, and of course the teacher must not expect such a closely shaded "mass" shape as would be produced at a later stage in pastel work.

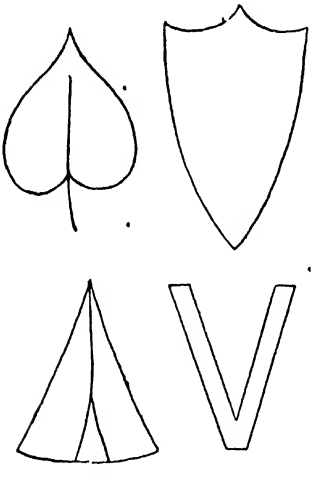
(4) *Colour Work.*—The use of colour in free-arm work is not only an attraction in itself, but it affords to the teacher a means of giving the children sufficient practice to attain some degree of manual dexterity without wearying them by too obvious repetition, *e.g.* when a class has drawn a ball of yellow wool, it may be allowed to draw a red ball from Froebel's Gift I., a blue rubber ball, and later two or more balls together (see also Course Suggestions below). As a rule, colour is more suitable for the drawings in mass than for outlines, since a coloured outline tends to distract attention from surface to edge, and so makes it harder for the child to criticise and correct his own efforts.

(5) *Designing.*—The elements of design may be taught in connection with free-arm drawing, especially such points as symmetry, repetition, and balance. Design, however, presupposes plan, and is best worked out on a geometric basis. Coloured tablets or cardboard shapes may be used to supply the geometric elements, and the children allowed to exercise their originality by "making patterns" with these, and then copying their own designs in free-arm drawing. The practice of allowing floral designs at this stage is not to be commended, since this so easily degenerates into distorting natural forms to fit a given geometric shape, long before the child is in a position to appreciate the appropriateness of conventional ornament.

The value of repetition in design may be occasionally illustrated, especially where wall-boards are used, as follows. When in a lesson each child has drawn, say, a flower of bold and simple form, such as is suitable to free-arm work, from observation, the class may be allowed to draw in the intervening spaces any,

nature sketch they please, from memory. The result will form a sort of frieze in which, to the regular repetition of the first study, is added variety imparted by the individual choice of memory subjects. It is not, however, desirable to allow such attempts to be in any degree permanent, since though they afford the children the pleasure of a sense of productive power, they are not likely to improve their artistic sense. When, therefore, the general effect has been noted, remove them, and leave really good examples of decorative art to, steadily if insensibly, influence the children.

(6) *Ambidexterity.*—Lateral symmetry is often taught by using both arms at once, and in the case of simple movements this method is quite successful. Taking a piece of chalk in either hand, and regarding his own upright body as a central line, the child moves both arms simultaneously in the same fashion, swinging them in curves outwards from the body, drawing them in oblique lines inwards towards each other, and so on (Plate XXII and Figs. 1 to 4). Now recent investigations tend to prove that it is undesirable, if not physically harmful, to attempt to produce equal skill with both hands or arms, and that the specialising of manual dexterity is the normal and healthy condition. Hence, though such exercises as those above mentioned are useful, and just as beneficial as combined arm movements in drill, it may not be amiss to caution the trainers of young children not to push ambidexterity too far.



FIGS. 1, 2, 3, 4
FORMS SUITABLE FOR AMBIDEXTROUS DRAWING
1. LEAF 2. SHIELD 3 TENT 4. GIANT LETTER

(7) *Free Illustration.*—As has been already mentioned, free-arm drawing is only suitable for "recreative" or illustrative drawing to a limited extent. In making pictures containing numerous details, many of such details must be drawn on rather

a small scale, and small drawings are generally *hand*, rather than *arm* work. Pictorial backgrounds upon which details are to be super-posed (as, for example, backgrounds for paper-cutting figures) are very suitable to free-arm work, as also are the larger objects in the pictures, lineal representations of human figures, etc.

Use of Tools.—Each child must be provided with board, chalk, and duster. The chief varieties of boards and their arrangement will be mentioned later. The dusters should not be too large; small netted dishcloths are good, being soft, light, and easily cleaned. After each lesson they should be shaken free of dust in the playground. As they are seldom used until the end of the lesson, the atmosphere of the room need not be full of dust.

About half a stick of chalk should be used at first. It is picked up by the thumb and two fingers, the end towards the palm of the hand, and as it is picked up, so it is held and used (Fig. 5). The end of the chalk should not be pointed, as fine lines are not to be desired. When the children reach a higher grade, say Grade III., pastels may be used instead of chalk. They make less dust, and can be obtained in a better variety of colours. Being thinner sticks than chalk, however, they are not so suitable for the tiniest children, requiring greater muscular control in the holding. Paper-covered pastels are not very suitable, as the drawing wears them quickly down to the paper. Pastels are soft and easily break, but since quite short pieces are usable, this does not matter. The *side* of the chalk end is held against the board or paper, the bent knuckles of the third and fourth fingers just escaping the board, and the hand being as a rule under the drawn line in verticals, and to the right of the line in horizontals, so that each line is fully visible to the child while drawing.

FIG. 5.—PICKING UP, AND HOLDING CHALK

Schemes of Work.—The scheme of work will, of course, vary with the conditions of each school, but it may be useful here to suggest certain broad principles the working out of which can be modified as circumstances require.

1. The arms swing more freely in curves than when straight lines are drawn, hence curvilinear objects will be taken first.

When right lines are drawn, vertical movements are easier to control than horizontal, hence the drawing of upright objects will precede those in which most of the lines are horizontal.

2. Large movements are freer than constricted ones, therefore such an object as a hoop would be practised before a ball.

3. Let the children draw things which interest them, to ensure voluntary effort; hence the teacher would largely include toys among her models.

4. Planes, linear objects, or solids of which all views are alike, will of course be drawn before any difficulties of perspective or of balance are introduced.

5. In order to train the child to observe accurately, begin with well-pronounced contrasts, passing on to those which are less marked.

The amount of work covered naturally depends not only on the stage of development of the children, but also upon the time which can be devoted to the subject. In schools where few branches of handwork are taken, drawing in some form should find a daily place on the time-table. In the upper classes of the Infants' School—Grade III., and Standard I. or Transition Class—the children are exercised in many way of using eye, hand, and memory, and two or three lessons weekly spent in actual drawing are usually all that can be given. In the lower grades, too, the drawing should be mainly arm work; in the upper classes some time is to be spent on arm work and some on hand drawing.

For a large school or kindergarten where the grades are well divided, the following scheme may be suggested as a type:

Grade I.—age 4 to 5 years.—1. To draw simple objects, preferably playthings, based on the circle, introducing few and short straight lines; for the training of observation of form, and colour selection: *e.g.* child's hoop; balls, various sizes and colours; toy balloon on string; ball suspended by a cord (Gift I.); ball-frame wires, with balls out; fruits which are almost spherical, such as oranges; clock-face, with or without figures; watch and chain.

2. Illustrations, or free drawing: *e.g.* smoking chimney; toy black cat; Christmas pudding; snow man; loaf of bread; weather drawings, such as sun in sky, or rainy day.

Grade II.—5 *to* 6 *years.*—1. Simple objects necessitating the use of curves, circular and elliptical, and of straight lines: *e.g.* circular—bat and ball; banjo; tin rattle; gong and stick; elliptical or oval—plums; eye-glasses; wooden spoon; Japanese lantern; right lines—strips of ribbon; rolling-pin; dumb-bell; flag; ninepins.

2. Practice in lines. (*a*) Comparative depth of curves, taken with bent canes, or cords looped between pegs. Follow these exercises with such objects as skipping rope, and bow and arrow; an egg and an orange; wooden coat-hanger and a broken hoop; saucer and cup.

(*b*) Comparative length of lines, taken with such objects as T-square, picture frames, and flags.

(*c*) Direction of lines, taken with laths or rulers; followed by exercises in copying position of limbs in drill or play movements, straight-lined letters, and objects in which some of the combinations made by rulers or laths occur.

3. Child's impressions of simple objects, such as class-room door, gas bracket in room, pillar-box, etc. Nature drawings of twigs, and very simple flowers, leaves, and fruits.

4. Copying designs made by children themselves with tablets, circular counters, stick and ring laying, etc.

5. Free drawings or illustrations of story lessons, the teacher to suggest the passage to be illustrated—*e.g.* Eskimo igloo, castle gate, bridge, house.

Grade III.—6 *to* 7 *years.*—1. Objects presented for drawing to be of increased difficulty, and greater accuracy of eye and hand expected; *e.g.* the objects chosen may be based on circles and ellipses, but will need the addition of details, such as the handle of a cup, the spout of a teapot, the tapering root and the bases of stalks of a turnip. Others of more difficult outline may be included, such as a bell, a kite, a clay pipe with a soap bubble, a carrot, etc.

2. Exercises in copying direction, comparative lengths of lines, depths of curves, etc., to be given as in preceding grade, but observation of slighter differences may be expected: *e.g.* basket and pail; wooden soldier and jumping Jack; acorns in cup; bananas and lemons; open matchbox; horseshoe.

3. Recreative drawing, such as making simple pictures with the teacher's assistance, for the pleasure it gives, and also as a training in expressing posture and movement.

4. Memory drawing of objects similar to those given in paragraph 1, page 191, the object being shown and discussed, and then withdrawn.

5. Free drawing, illustration of stories, etc., as in Grade II.

Grade IV.—7 to 8 years.—1. The work of Grade III. with objects of slightly increased difficulty, *e.g.* whip and top, trumpet, monkey on a stick, toy pistol, jar of jam and spoon, water bottle, front of easel.

The nature drawing should include budding twigs for comparison of branching, leaves of various forms, simple flowers drawn in mass or in outline, mistletoe, sycamore keys, pea-pods, etc.

2. Memory drawing of objects seen on the way to school or at home, such objects to be of some uniform type, so that it may be possible to discuss the drawings collectively.

3. Lessons to give the child an idea of representing objects at various distances, *e.g.* telegraph poles, railway signals, trees, etc.

4. Lessons in representing correctly relative sizes, *e.g.* dog and kennel, cat and mouse, boy and door, egg and egg-cup, engine and tunnel.

In a rural school, or a small infants' department or kindergarten, the grading cannot be so complete. Sometimes all the infants have to be taught in one group. In such cases it is best to curtail the scheme by dealing with a few objects only in each section, with the whole group of children, enough to guide them in observing and reproducing. After initial difficulties have been overcome, the objects to be drawn may be varied with individual capacity, since it is not necessary for every child to be drawing the same thing at the same time in every lesson.

Methods of Work.—Reference to the suggested scheme will show that real things are to be drawn in every grade, and, as has already been pointed out, these things must be interesting and familiar to the children.

1. *Discovering the Use of Mass Drawing.*—Give a young child chalk and a board; he will immediately scribble, almost invariably in curves. The teacher may add a few lines to the curved scribble,

turning it into "a picture" of a tree, a smoking chimney, a steaming kettle, etc. (Figs. 6–8). The child thus discovers that

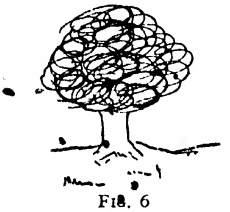


FIG. 6

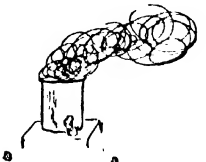


FIG. 7

FIG. 8

lines can be adapted to express ideas, and is eager to "draw something."

The teacher then helps him to make larger scribbles, less spread out across the board (Fig. 9), which he will at once recognise as a hoop. She shows him how much easier it is to make a big hoop if he stands away from the board and swings his arm round. Do not let him rub out errors in form; the faults in the first curves will be partly corrected in the subsequent turns of the spiral, and a fairly respectable circle will result. As before, the hoop may be quickly transformed into a wheel, a clock-face, and so on.

In the next stage, present a large coloured india-rubber ball to the children, *e.g.* a yellow one. After discussing its colour, use, etc., and letting some children feel and hold it, and roll it about, put it aside, and let the class attempt to draw it, selecting their own chalk. If, as is possible, they at first draw a yellow "hoop" only, a further comparison of hoop and ball will suggest the filling up of the circle with yellow.

Now, suppose the teacher winds, in the presence of the class, a ball of red wool, inviting their attention and remarks as she does so. When they are afterwards allowed to draw this ball, a certain number will very probably build it up in line as it was formed by winding, *i.e.* they will begin centrally, and make larger and larger spirals till

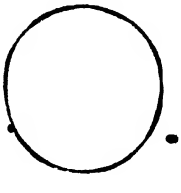


FIG. 9

FIG. 10

the full size is attained. Thus they have discovered two ways of getting the same form, and can use whichever seems to them the more convenient. If sometimes their sketches are too small, they will find that it is easy to add to them, and so will gradually discover that, as a rule, it is better to begin in the middle and work outwards, since in that way errors are more easily rectified (Fig. 10).

A Gift I. ball hanging by its cord introduces the use of a vertical straight line; a ball into which has been thrust a wooden knitting pin or a large bone crochet hook leads the child to observe the direction in which the straight line must be drawn, and so on.

2. *Comparative Sizes.*—Practice in drawing two or more balls together will draw attention to comparative sizes—a small ball hanging over a large one, below it, on its left, on its right, a large ball between two small ones, and so on.

In such exercises it is useful to suspend the balls against a background similar in colour and size to the surfaces on which the children have to draw. This makes it easier for them to judge size correctly.

3. *Position of Objects.*—A strip of ribbon arranged first centrally, then near to an edge, of a sheet of paper or a millboard, like that upon which the children draw, will call attention to position.

Ribbons of various widths, arranged vertically, horizontally, and obliquely, afford the same practice in comparing widths, lengths, and positions in right-lined surfaces as balls do in curvilinear objects. Marked contrasts would of course be used first, and it is obvious how such exercises may lead up to the drawing of flags, windows, T-squares, giant letters, frames, etc. (Figs. 11, 12).

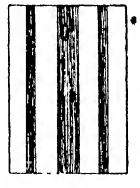


FIG. 11.—RIBBONS —COMPARATIVE WIDTHS

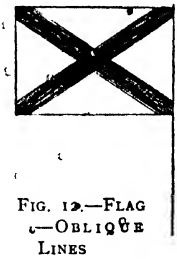


FIG. 12.—FLAG —OBLIQUE LINES

4. *Analysis of Form.*—A carefully graded selection of objects to be observed and drawn will lead the child insensibly to acquire the habit of noting whether things are spherical, oval, right-lined,

or what not. Now, analysis of form is a most important factor in drawing, and this habit will in later years help to the sensible "blocking-in" of forms, instead of the custom, unfortunately not yet quite dead, of measuring details by a sort of lattice work of construction lines which have no ultimate meaning in the sketch.

5. *Comparative Depth of Curves.*—To assist the children to note the difference between a circular and an elliptical curve, occasional lessons or preferably parts of lessons may be devoted to line practice. The excitement of watching a changing shape, and demonstrating his ability to observe correctly, are abundant proof of the pleasure the child takes in using eye and hand. The dolls'

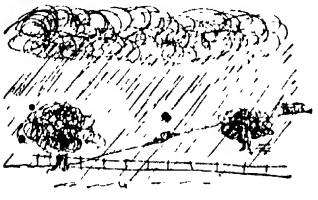


FIG. 13.—RAINY DAY

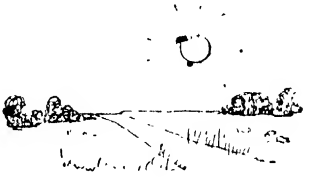


FIG. 14.—SUNNY DAY

FIG. 15.—WINDY DAY

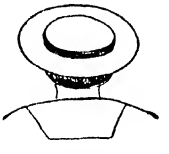


FIG. 16

clothes-line curves only slightly between the props. A skipping-rope droops deeply below the hands. A long piece of cane makes Hiawatha's bow, but it may also form the back of a bentwood chair. A low mound of sand may similarly be compared with a "steep hill."

The child discovers such differences in curvature readily when they are presented to him in pairs, one of the pair rapidly following the other. He is thus ready to appreciate the curvatures in such things as orange and banana, head and shoulders of a boy (back view), or cup and saucer, these objects forming the subject of lessons subsequent to the line practice (Figs. 15, 16).

6. *Length of Lines.*—The habit of observing relative lengths of

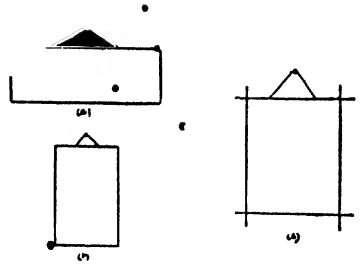


FIG. 17.—PICTURE FRAMES—COMPARATIVE LENGTHS OF LINES

lines is cultivated in a somewhat similar fashion, rulers or laths being used for demonstration. Towards the end of a drawing lesson the teacher might take two laths of very unequal length and get the class to draw them while held side by side vertically, one above the other horizontally, at right angles forming T, L, or a cross †, and also similar forms with the short lath vertical. In succeeding lessons the children would draw the frames of pictures in their class-rooms, long panel pictures first, and later those which are more nearly square (Fig. 17, *a*, *b*, *c*.)

7. *Direction of Lines.*—The direction of lines is very interestingly studied from drill exercises. Children usually find it easier to note limb movements first; *i.e.* they more readily represent an arm by a single straight line than they do the trunk of the body. So in the earlier stages let a child hold one arm straight out from his side, stretch it upwards, obliquely sideways, etc., while the rest of the children "draw his arm." Follow this with the drawing of a toy railway signal, or perhaps with the memory drawing of real signals seen near the school. Exercises with two arms, straight or bent at the elbow, may follow, also leg movements, etc.

Dancing Jack, monkey on a stick, jointed Dutch dolls, jointed wooden or cardboard animals, and many other toys are very useful here, drawn either in line or mass, the former being often more useful in free-arm drawing at this point, to cultivate the sense of length proportion (Fig. 18).

Fire-screens, easel-shaped and panel-shaped, form good models here, also large wooden com-

FIG. 18.—MONKEY ON STICK

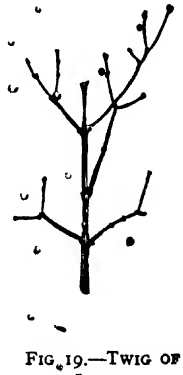


FIG. 19.—TWIG OF LILAC

EXERCISES ON DIRECTION OF LINES

passes, partly opened matchboxes, sticks from which are hung a gipsy-kettle, etc.

8. *Nature Drawing.*—The degree in which the children have profited by the foregoing exercises is beautifully demonstrated by their sketches of budding twigs, the accuracy with which they observe the angle of the branching, relative lengths of internodes, size and shape of buds, etc. (Fig. 19). Leaf drawings, too, will be more faithful, as well as their study of winged seeds.

9. *Movement.*—A further application of the practice of representing attitudes by lines is the use of linear figures in free illustrations. Such drawings are fascinating to young children, and while they are to them a delightful means of expression, they serve to show the teacher the stage which her class has reached in observation, visual memory, and judgment of position. Except as memory drawing, very few animal forms can be sketched by a class in school, so this practice in studying the positions of their classmates in active play supplies to some extent their desire to portray motion and life in their "pictures" (Fig. 20).

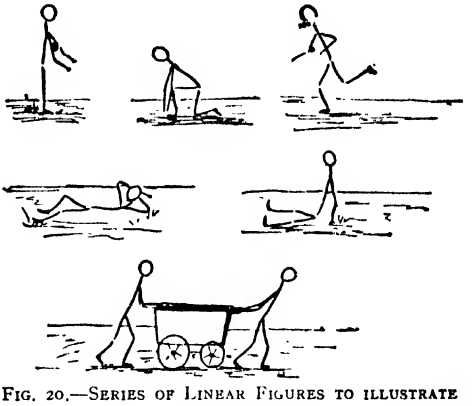


FIG. 20.—SERIES OF LINEAR FIGURES TO ILLUSTRATE MOVEMENT

10. *Free Illustrations.*—To help the children to express themselves more coherently in free illustrations, such exercises as those suggested in Grade IV. scheme, paragraphs 3 and 4, are useful. The typical object studied to express distance will, of course, be decided by the school locality, *e.g.* lamp posts or telegraph poles in a town, trees in the country lanes, or ships on the sea. But it is well to begin with upright forms rather than horizontal, and with objects much taller than the little folks themselves.

Children in this grade will have acquired some degree of freedom in illustrating a story episode, and if, after attempting

such an one, the teacher shows them a "real picture" of the same scene, allowing them to compare their own drawings not only with one another, but with it, they will soon discover how much clearness is gained by distinguishing foreground from background. Points raised in language lessons about a picture are soon utilised by the young artists in their subsequent drawing lessons, and a discriminating word from the teacher fertilises the germ of the idea (Fig. 21).

Toys or cardboard shapes are used for lessons on relative sizes. Give the children toy dogs, or the cut-out picture of a dog, and require them to draw a kennel door large enough for the dog to enter. Or provide each with a sugar mouse, and get them to draw a cat of proportionate size from a "memory" of the toy cat they had sketched on some previous occasion (Fig. 22).

FIG. 21.—APPARENT SIZE VARYING WITH DISTANCE

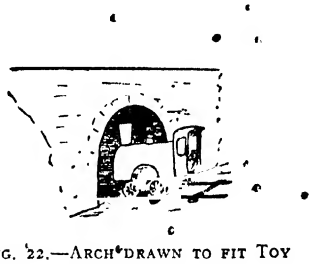


FIG. 22.—ARCH DRAWN TO FIT TOY ENGINE EXERCISE ON RELATIVE SIZES

Correlation of Work.—The correlation of free-arm work with nature study is so obvious as to need no further remark than to remind the teacher that natural forms requiring small detail are unsuitable subjects.

Geographical illustrations may occasionally be made from models such as the dome-shaped Eskimo igloo, the palms and tents of a desert oasis, or the wigwam of the Red Indian. Weather pictures, too, have already been mentioned (Figs. 13–15).

Stories, historical or literary, can often be illustrated not only from sketches of models as above, and by slight modifications of familiar objects, such as turning a tray into a shield, or a chopper into an axe, but also by sketches made of dramatic play, in cases where the scene is not complicated (see paragraph on "Movement" above).

Free-arm Writing.—But as distinct from these, in which drawing serves rather as a means of giving back impressions which have been received, free-arm drawing is a direct means of instruction in writing. In point of fact, cursive writing is in its early stages a part of drawing, and the beautiful free curves that can be produced by arm-movements are surely the best foundation for good, fluent penmanship. But they should not be regarded as *only* the foundation. If it is accepted in drawing, that the arm muscles are stronger than those of the hand, and the normal position in arm movements healthier than in hand and wrist drawing, it is only logical to recognise that these points equally apply to writing, and do not cease to be advantages as the child grows older. In a large number of business houses to-day, one finds that the clerks who need to write continuously for prolonged periods have almost invariably adopted a system of arm-writing, to avoid fatigue and "writer's cramp."

Marrs' Method of Free-arm Handwriting is intended to teach a system of arm-writing such as clerks use, and it is claimed that "legibility, freedom, rapidity, and endurance" are attained by it. The system is expounded and illustrated in a series of books. Such a method, although based on the same principles as free-arm drawing, differs from it in that in the latter the *whole* arm acting from the shoulder is used upon an upright surface, whereas in the former the *fore*-arm is the support and the propelling force, in writing upon a horizontal or nearly horizontal surface. It is, of course, a more advanced stage of arm work, more suitable and convenient for use in everyday life, and it forms a natural transition from the arm work of the kindergarten to that of the upper school.

Transition from Arm to Wrist and Hand Drawing.—Although free-arm drawing is so valuable in the early stages of the child's education, it cannot, obviously, be regarded as all-sufficient. No drawing course would be complete without the use of the flexible as well as the rigid point, and the sketching of accurate details as well as of general impressions.

While the observing and reproducing powers are being exercised in free-arm drawing, the hand is gradually gaining power in feeling, holding, regulating pressure, and so on, by manipulation

of objects. Quite tiny children are able to draw with their fingers or with sticks in sand, long before they could manage a pencil comfortably. By the age of six or seven years the desire to insert details in their pictures will lead them to use their fingers as well as their arms in drawing; and provided the teacher corrects bad attitudes, and keeps the drawing surface as nearly parallel to the face as possible, it is quite permissible to allow both methods occasionally, although up to the age of nine or ten the arm should be the most frequently used.

Use of Free-arm in Senior Departments.—Then comes a stage when pastel work is very suitable to replace mass-drawing, greater smoothness of shading and more gradual blending of colour being necessary than would be possible or desirable in free-arm work. The pencil will now also be used for line practice, and the brush for fuller control of colour.

Arm work should, however, continue to be used occasionally to prevent the child falling into a habit of niggling detail work, or of stooping, as well as in free-arm writing, as has been already mentioned.

Apparatus.—The arrangement likely to secure the most healthy attitude and freedom of movement is the provision of wall boards for all the children.

Wall Boards.—They should be so fixed that the lower edge is about 18 in. from the floor, the height of the drawing surface being about 20 in. Such boards as these, students' size, are quoted at the rate of 15 ft. of board for 35*s.*, subject to discount.

Where this expense cannot be met, strips of American cloth or slate cloth make a fairly durable and satisfactory substitute. If the wall is not smooth, the American cloth should be backed with millboard. Laths should be nailed over the upper and lower edges of the cloth, to prevent fraying. The playground wall might be utilised in this way with great advantage, as the drawing class can then be very frequently held out of doors; but however smooth the wall may be, a special drawing surface should be affixed to it, lest the children form a habit of chalking on walls not intended for the purpose.

It is very important, in choosing one of the many board substitutes, to make sure that the composition is one which will not

wear greasy in the course of a few months. Wood is, on the whole, the best, as the surface can be periodically renewed at trifling expense.

Desks.—If standing space is not available, there are several convenient arrangements for desk drawing. A type of desk should be chosen in which the hinge of the top is set far back, so that the raised flap is almost upright, and which allows plenty of room for the child to stretch his arms in drawing (Plate XXIII). The desk in the illustration cost 13*s.* 6*d.* On the ledge of the flap is rested the drawing board—a 3-ply wooden board 11 by 15 in., blackened on one side, and light in weight Some teachers use millboards on which a paper is fastened by spring clips. This plan has the advantage of permitting the use of variously tinted

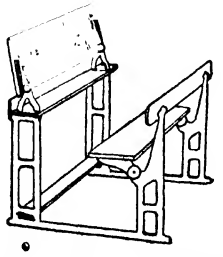


FIG. 23.—DESK WITH BLACKENED FLAP

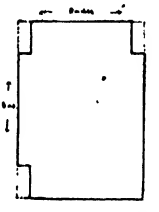


FIG. 24.—BOARD, 11 IN. × 15 IN., NOTCHED TO FALL INTO DESK-SLOT, 8 OR 9 IN

backgrounds, to suit the colour of the object to be drawn, thus producing a more artistic effect. It has, however, the counterbalancing disadvantage of multiplying the articles to be distributed for each lesson, thus probably wasting time, especially for the lower grades, the children of which are always slower in providing themselves with utensils. Also, small children are sometimes unable to attach the clips firmly.

Some desks, of about the same price as those already mentioned, are now provided with flaps blackened on the under surface. This plan saves time, as the board is always ready when the flaps are raised, but the drawing surface is rather narrow from top to bottom (Fig. 23).

Schools furnished with the old-fashioned types of desk, in which the top is either hinged in the middle, or not at all, may

adapt them to some extent to free-arm drawing by using two boards for each child. Put one board in the slit at the back of the desk, turn up the flap, and rest the second board on the ledge of the flap, leaning against the upright board. The trouble is for the child to keep it quite steady while drawing.

Or, the board may be made larger than the desk slit, and notched at three corners (Fig. 24), so that it falls only a short distance into the slit, and is supported by the leverage of the back of the desk. The object of notching three corners, instead of only two, is to allow of the board being arranged either as a horizontal or an upright oblong. Provided that the child in the desk in front sits quite clear of the board behind, this plan is satisfactory.

Summary.—To sum up: Free-arm drawing is, especially on physical grounds, the best method of drawing for young children, and, by reason of its adaptability to many branches of drawing, is an excellent basis for art education.

Up to the age of six or seven the drawing should be almost entirely arm work; thence to the age of nine or ten hand drawing should be gradually introduced; and after that age, arm-work should be practised habitually in writing, and occasionally as a corrective in drawing, while the bodily position and the arrangement of the board should be retained as far as possible in hand drawing throughout the school life.

BOOKS FOR REFERENCE.

J. LIBERTY TODD: *New Methods in Education* (Orange Judd Co., New York). *Primary Education* Magazine (Primary Education Co., Boston, U.S.A.).; *Marr's Method of Free-arm Handwriting* (R. A. Marrs Co.).

LX. COILED OR STITCHED BASKETRY

By Miss Isabel Thwaites

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The Elements of Basketry.—There are, broadly speaking, two kinds of basketry: (i) woven and (ii) coiled or stitched baskets. It is proposed in this article to deal only with coiled basketry, giving a description of the various stitches, to be followed by some suggestions on the teaching of form and design, and ending with a very brief sketch of the history and use of Indian basketry. Teachers will then be able to adapt the work to the capabilities of their own children, as what is possible in one school may not be possible in another.

Before beginning the teaching of basketry the teacher should carefully consider the question of the guidance necessary to enable the children to work out their own ideas. If, from the circumstances of the school, any teacher feels that the children cannot work with only a *reasonable* amount of guidance, it will be better not to undertake the work, as it would thus be too difficult a task for the teacher and of little educational value to the children.

In coiled basketry, knitting, and crochet work, the initial steps *must* be taught, as the fabric itself has to be fashioned, with tool and material, at the same time as the form and design is made. In needlework the fabric is ready to hand to be cut to the required form or shape, or to receive the intended design, and the children can, to a great extent, see for themselves how the stitches could or should be made to complete the form or unfold the design.

The stitch being learnt, there are in basketry endless opportunities of development within the power of the worker. Similarly, a child who has learnt how to form an oblong and a triangle in basketry finds that the most intricate design is not beyond its powers.

How to Begin.—It is advisable, if possible, that the stitch be taught before learning how to begin a basket. Even with an adult class it is more satisfactory to give each pupil a small piece already begun, upon which to learn the stitch. When one stitch has been learnt, the properties of the materials will have been discovered, and then it will be much easier to begin a basket, and adults and children over eight years of age will experience no difficulty.

In my school, consisting of infants and Standard I., each assistant begins two baskets weekly, and so there is always a good supply ready. A few pieces are kept for beginners. As soon as the stitch is learnt, a new piece is given, the old pieces get larger and so are better to learn upon.

In a school where the work is being taken for the first time, it is a good plan to teach two children, who in turn will teach two more, and the four each taking a pupil will raise the number to eight, and soon the whole school will be at work. The desire to have a new piece upon which to begin a basket of their own will prove a strong motive to the pupils, and work will proceed briskly and happily. A bag for each child's basket is a great advantage.

Experimenting.—As an experiment I recently allowed my children to leave the baskets they were making for a time, and left them free to choose material and stitch and to begin a basket in any way they preferred. Class II. children used raffia to begin with. In Class I. some used raffia and some used cane as a foundation. Standard I. all chose cane.

Some years ago I tried to teach Standard I. how to begin a basket. I spent much time in the trial, and the result was an utter failure. Yet, in this last year, when the children were left entirely to their own resources, the results were amazing. In beginning with cane, the children did not even have it soaked—*I* would not like to begin with dry cane. They made a variety of articles: baskets with handles and lids, cups and saucers, plates, furniture; no difficulty seemed to present itself to them. Of course the results were very various, some being very poor, but in no case was there lack of good attempt.

These experiments have made me decide to retain coiled

basketry. They have convinced me that by keeping it, I am not violating the principle of self-development. Once the work of learning the stitch is mastered, the children can go ahead, and there is scope in the craft for the most gifted and enough of interest and simplicity for the weakest.

In a small Lancashire village the head mistress of a girls' school learnt the work. She was not a very apt pupil, but she taught her assistants and the teachers in the Infant School, and in a short time all the children had learnt some stitch—the elder girls beginning baskets for the younger ones. The girls took their baskets home each night to work at them, and a really useful and beautiful work-basket was the result of their labours. I had the pleasure of visiting the school to see the work, and great was the joy of the girls in showing me their baskets. The like joy was very evident in a school in Norfolk that I visited, where the teacher had only had the help of a little correspondence.

Kinds of Baskets.—Round, square, and oblong baskets may be made. As one can be developed from another, directions will now be given for making round baskets upon a cane foundation, to be followed by a few suggestions for using foundations of raffia, hay straw, dried rushes, etc.

The Various Stitches Employed.—These have each their own particular forms, merits, and effects, which should be thoroughly understood by the teacher.

Lazy Squaw.—To begin a basket in this or any other stitch for which cane is used as a foundation, let the cane (No. 5) be soaked at one end for twenty-four hours. The cane should be coiled round at the other end and tied with raffia. As more cane is required, the raffia tie can be slipped farther round the coiled cane. This precaution keeps the work tidy and prevents the cane getting broken.

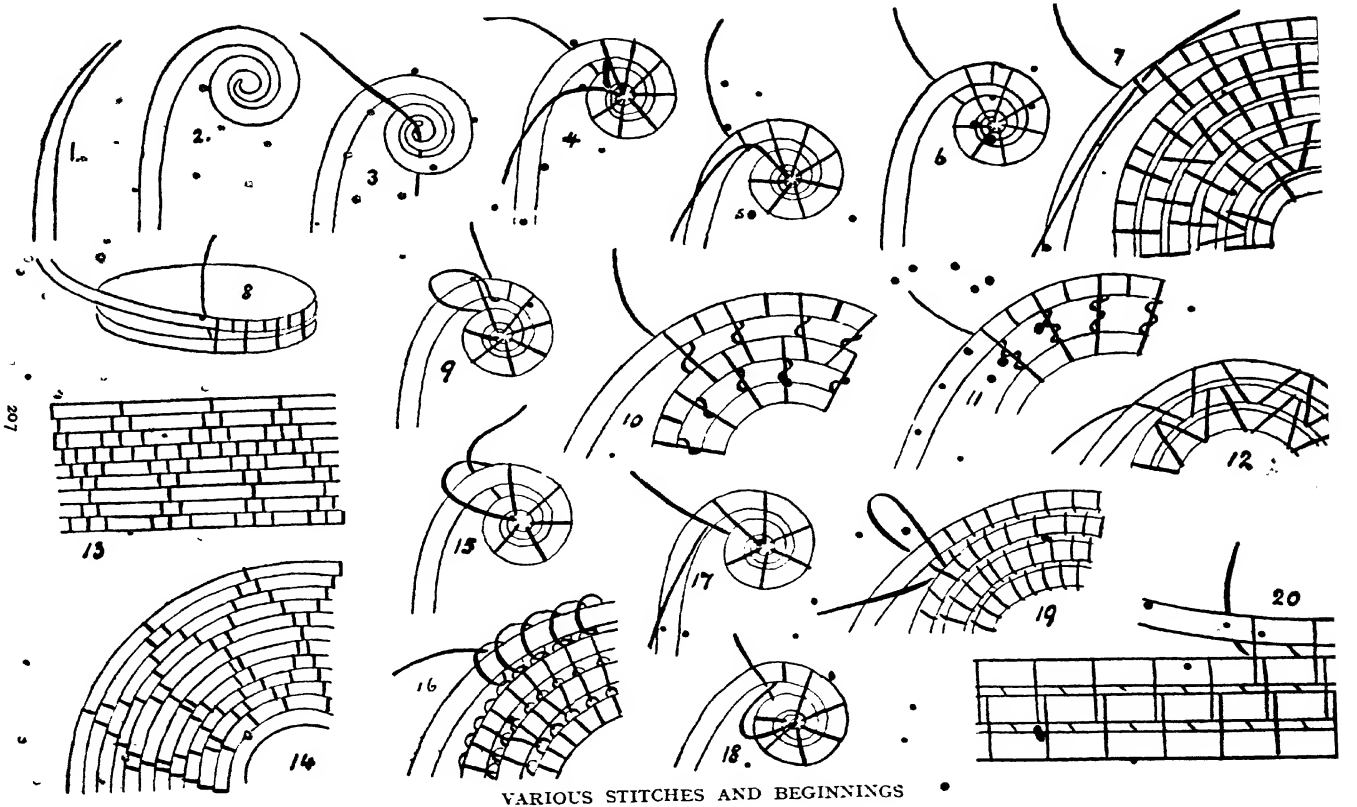
To begin the basket, have a needle (blunt tapestry, No. 18) ready threaded with a strand of raffia, which should be split if too wide. From the soaked end, pare away half of the cane for about 2 inches (Fig. 1). Draw a pencil quickly along 5 inches to make the cane more pliable; and, to form the centre, curl the cane twice round a thin pencil or wooden meat-skewer (Fig. 2). The curled end must be held very carefully

or it will slip undone. Insert the needle from the front, keeping the short end of raffia in its place with the second finger and thumb (Fig. 3). Continue to insert the needle from the front, working from right to left (Fig. 4). In the second row, insert the needle under the loose cane (Fig. 5)—along which will lie the loose end of the raffia—bring the raffia to the front again and insert the needle into the centre (Fig. 6). Repeat this short and long stitch till the ring is complete.

In the third and succeeding rows, make the wrap round the loose cane and insert the needle into the hole caused by the short stitch (or wrap round cane) in the last row. Repeat this till the ring is finished, with this addition, that whenever the stitches seem to pull back, a second short and long stitch should be made for the same hole (Fig. 7), thus making an extra stitch. These increases are needed more frequently while the rings, or—more correctly—the coils, are small. Repeat as in the third row till the work is large enough to form the base of the basket. In the fourth and following rows, instead of putting the needle under the cane, slip the raffia under with the finger and thumb. This change saves time and may be applied to other stitches.

When a new piece of raffia is required, lay it along the cane and work over it for about six stitches (Fig. 7). Gently pull the long end or new piece (hanging down on the left) till the short end disappears. Then thread the needle with the new strand and work with it over the old end and the cane together for about six stitches and cut away the old end. Coloured raffia is laid on in the same way—the strand of raffia not needed for the immediate stitch being carried along with the cane and covered with stitches.

When more cane is required, pare off half of the upper part of the old piece for about 1½ inch, and do the like with the under part of the new piece; put the two together (splicing) much in the same way as the new piece of raffia is added, allowing a short length to go past its place until a few stitches have been made. The new piece should then be pulled gently till the end disappears. This precaution saves the risk of the new cane slipping out. When large enough, let the cane lie on the *upper* side of the base (Fig. 8), and work the sides till the required height is reached. Then cut the cane, leaving about 2 inches, pare off the under part and work



VARIOUS STITCHES AND BEGINNINGS

to the end. To finish off, work over odd stitches and cut the raffia close to the work. If the sides of the basket are to be straight, no increase is needed. The third basket shown on the Frontispiece is worked in Lazy Squaw.

The Nigerian or Single-knot Stitch.—To work this, begin as in Lazy Squaw and proceed as shown in Figs. 1 to 6. Then bring the raffia with the finger and thumb to the left of the long stitch, and insert the needle to the right of the same stitch (Fig. 9). This gives the appearance of a knot (Fig. 10). The cane does not lie along as closely as in Lazy Squaw. The seventh basket in the coloured plate is worked in the Nigerian stitch.

The Samoan or Double-knot Stitch.—This is worked like the Nigerian, with this addition—that the raffia is brought to the left of the stitch and the needle inserted on the right a second time (Fig. 11). In this stitch the cane is still farther from the last row and wider raffia is necessary. The Samoan is not suitable to use throughout the making of a basket, but a few rows as an insertion are very effective.

The West African Stitch.—When worked, this stitch has the appearance of knitting. Begin as for Lazy Squaw (Fig. 6). In the second row put a second long stitch into the first hole (separated from the first by a short stitch). Then make a long, a short, and a long stitch for the next hole (Fig. 12), thus putting two long stitches separated by a short stitch into each hole, and passing to the next hole with a long stitch—not separated from the last by a short stitch, as in Lazy Squaw. To increase, make an occasional long, short, and long stitch into the space between the two long stitches of the previous row.

The Peruvian Stitch.—This is a very simple variation of the Lazy Squaw, but, though very dainty in appearance, does not make a very strong basket, and therefore the use to which the basket will be put must be considered before employing this stitch. Begin as for Lazy Squaw, and in succeeding rows increase by wrapping round the cane, making short stitches. The long stitches make the pattern either singly or in pairs separated by one short stitch. Figs. 13 and 14 indicate some of the variations. Single or double diamonds, single or double lines straight or slanting or a combination of both, are very

effective even without the introduction of colour. It is a stitch more suitable for older children, as, if worked slackly, the basket is very unstable and gets out of shape. The base of the basket would do well in Lazy Squaw, and a single or double row of the same, introduced into designs which allow it, give more strength to the basket.

The Fuegian Stitch.—Begin as for Lazy Squaw (Fig. 4). Throw the raffia over the left hand, insert the needle into the centre, bringing the point in an upward direction to the left of the raffia from the last stitch (Fig. 15). When the needle has been pulled through in an upward direction and the movements repeated till the ring is complete, a series of loops will be seen into which the needle will be inserted in the next and following rounds (Fig. 16). When a new strand of raffia has been laid on, before working a stitch with it the needle should be passed through the loops formed by the last stitch so that the continuity of the loops may not be broken.

If coloured raffia be used for the design, it must be kept, when not being used, as much as possible at the back of the cane, as it has a tendency to show between the stitches if at the front, the stitches not being as close together as with most of the stitches. The Fuegian has the appearance of buttonhole stitch worked from the person instead of towards the worker as in embroidery. The second basket on Frontispiece is worked in this stitch. The cane foundation is partly visible and shows especially in the green trees.

The Pima Stitch.—Baskets Nos. 1, 4, and 5 on Frontispiece are made in this stitch. Begin as for Lazy Squaw (Fig. 4). Bring the raffia to the front (Fig. 17); wrap once round the cane, bringing the raffia to the front again, and insert the needle into the centre (Fig. 18). When the round is complete, insert the needle between the last two rows (Fig. 19). In the diagram the stitches are shown a little apart from one another for the sake of clearness, but in working, the stitches should be as close together as possible at the point of insertion. On the upper row, however, the stitches need not touch, as it will, in turn, be covered. As the circumference becomes larger, this difference between the two rows will not be so noticeable, the stitches being almost equally close together in both rows.

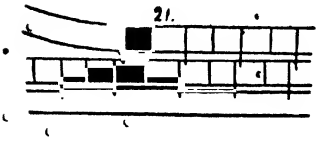
For this stitch a finer (narrower) strand of raffia may be used. Very beautiful work may be done if very fine strands are used, but this takes a longer time and is not suitable for young children. By them, a little finer raffia than for Lazy Squaw should be used.

A variation of Pima stitch may be made by wrapping the raffia two or three times round the upper cane before inserting the needle under the lower coil. In effect, the work presents an uneven appearance. When coloured raffia is used for the design, the raffia must be put round the upper cane only once before inserting the needle, as, otherwise, the self-coloured raffia would show and so spoil the design. Between the designs, the more frequent wrappings may be made. This variation may well be used for the base of the basket to save time, using the Pima stitch itself for the sides and lid.

Other Foundations.—Different materials for foundations will now be dealt with and additional stitches described. Any of the stitches already given may be used with a raffia foundation, but cane is better for children (except the youngest, who use soft string) to *begin* with, as the raffia foundation needs regulating, and this gives a child too much to think of at first.

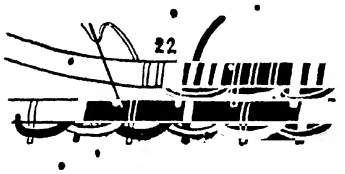
Stitches for the Youngest Children.—In the upper division of the Nursery the children use soft thick string and coloured knitting cotton. Older children begin them thus: Coil the string sufficiently to allow for over-sewing it with the knitting cotton. They then work a row, and the work is ready for the little ones, who pass the needle over two coils of string all the time till the basket is finished. The same movement is used in the making of woollen balls. In making the basket, a tool—the needle—is used and is put under the lower coil (Fig. 20), whereas the ball goes into the centre hole. Thus this simple stitch forms a good progressive movement from the known to the unknown.

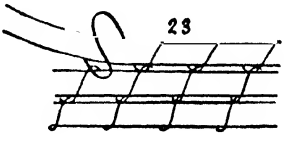
The Syrian Stitch.—The base for a basket in this stitch will be similar to Lazy Squaw, except that the long stitch is made *into* the lower coil (Fig. 21), instead of under it. The foundation for this and the following stitches is composed of raffia, which is perhaps useless for making stitches, *i.e.* thin ends



taken from strands which were too wide, or harsh lengths, hay, straw, old hat-straw, or any other material that is suitable to combine with raffia, and in addition, a coil of cane. The cane must be kept away from the top of the coil or the needle will not be able to enter. The cane gives strength to the shape of the basket.

To make the Syrian stitch, a needle must be used for each of the two strands of self-coloured raffia required, and others added for each colour used. The coil should be very thick, and may be as thick as an adult's finger. Wrap the raffia round the coil as in Lazy Squaw once, twice, or three times, according to the width of the raffia and the size of the stitch required, insert the needle into the lower coil not far from the top, and bring the needle to the front on the right of the stitch just made and throw the needle and strand to the back of work and to the right. Take another threaded strand, which should have been previously added to the coil in readiness, and repeat as with the first stitch. Next, take up the first needle and pass it under the coil to the back, then wrap round and repeat as before. The throwing back of the strand each time ensures the loops at the front coming *over* the previous loop and from *under* the succeeding loop (Fig. 22).





The stitch, though it seems confusing at first, is not at all difficult, and children of seven and eight years of age can do it quite easily. It is very effective and makes handsome large baskets. The basket from which I took the stitch came from Damascus, and was made with materials that are too expensive for ordinary school work.

Embroidery Stitch.—The sixth basket on the Frontispiece is an example. The foundation for baskets made with this stitch is made of waste ends of raffia, with a stitch as shown in Fig. 23, which is simply passing the needle to the back through the loops of the

WORKING OF OBJECTS IN COILED BASKETRY

out would have been useless, therefore some lessons on the uses of baskets were given, in substance, as follows:

The children were told to pretend they were Indians gathering berries and fruit. How were they to be carried home to their huts? Various answers were given. Some suggested the gathering of leaves for the purpose. Many answers indicated the difficulty experienced by the children in realising the absence of modern conveniences.

One day they made a paper circle and with the waste cuttings fashioned imaginary berries and placed them on the paper circle, and at the teacher's direction moved rapidly down the room. Most of the berries fell to the floor. The children were asked how they could prevent the berries from falling, and at once began to turn up the edges. They were then led to see that for the carrying of large quantities the sides would need to be made high; that for food a wide open mouth would be required; for water, a constricted mouth would be necessary. They cut out shapes for baskets of every description.

I made a little carrying basket with sticks and knitting cotton. The children made one in free cutting, and marked it with lead pencil to indicate the netting. Reference was made to the use of the gourd in carrying water; how to protect it, a network of grasses was wrapped round, and a handle made with which to carry it the more easily and so lessen its chances of being broken. In time the gourd would break and fall away, leaving the network. This, in turn, was strengthened, and, later, lined with clay and sand and used to cook food. With use, the basket work wore away and left the clay. This result finally led to the making of pottery.

These facts make the work more intelligible and more interesting, and help the children to realise how *the use* of the basket must always be borne in mind when designing the shape.

Design in Basketry.—If basketry is to be taught intelligently, the subject of design must receive careful and sympathetic consideration.

Design as Self-expression.—A study of Indian basketry reveals the fact that the Indians wove into their baskets expressions of their hopes and fears, their loves and aspirations, just as we

do in poetry and painting, sculpture and needlework. In examining the many specimens of native work in the British Museum, the power of design and varying degrees of excellence in different tribes are very evident. In native work from other sources, the same conclusion was inevitable. The natives designed well because they felt intensely, and, unfettered by the repression of civilisation, they produced beautiful work with a very limited range of material.

The Use of Enlarged Copies.—In teaching, the labour of making enlarged copies of native work is well repaid. The children will realise that the work is beautiful because it tells a true story of a real life, and they will want to make a true story belonging to *their* own life.

In our school these drawings, 30 × 22 inches, are made, and, at times, hung upon the walls. The children examine them well, walking from one to another conversing about them. They cut papers of various shapes, including the square and oblong, the circle and triangle. These they compare with the drawings, and finally come to the conclusion that there are no circles on the sides of the baskets, and that all designs are made of oblongs and triangles. This latter fact reduces the work of guidance on the part of the teacher to that of leading the children to see how to make oblongs and triangles in basketry; and also on paper so that the design may be planned and kept for future reference as the basket takes time to make. With young children more guidance will be needed than with older children, and this guidance may well be given to them in the arithmetic lesson.

Designing with the Lazy Squaw Stitch.—As this stitch is the foundation for the greater number of stitches, designing with it will be taken first; and, of the two forms, the triangle being the easier, it will be wiser to begin with that also. To teach it, the following steps may be taken, omitting the earlier ones if the capacity of the children render them unnecessary.

(1) *Coloured gummed paper may be marked into divisions* 1 × ½ *inch by a higher class* (Standard I.).—These will be taken to represent stitches, and be cut off as required. Squares of plain paper 4 × 4 inches (approximately) can be turned into a triangle by marking the centre of the top line and drawing to each bottom

corner. These may be prepared in a previous lesson by older children. A paper stitch should be placed in the centre and two on either side, leaving equal distances between each. The children will see that in the succeeding rows the number of stitches will decrease (Plate XXVII, Fig. 26). The stitches of each row will fit in half-way down into the previous row, exactly as the stitches in the basket fit in between one another.

(2) *The stitches may then be drawn on a second and smaller triangle*, still fitting half of each stitch into the previous row.

This is necessary because the stitches fit in between one another in the basket—and to represent them in this way is literally correct—yet diagrams thus made are confusing to work from.

(3) *The stitches are next drawn above the spaces between each stitch on a third triangle* (Fig. 27).—The triangle doubled forms a diamond shape. These two shapes can then be drawn in a book, and the oblong dealt with in the same way. In the oblong, it will be noticed that to keep the outline of the design straight, the stitches will need, in succeeding rows, to follow the rule—in, out, in, out (Fig. 28).

The children may then be allowed to make designs for themselves. If needful, let the children cut loose stitches from ungummed paper and arrange them on the desk or table before drawing them in their books with crayons. They can either choose the one they like best to work into their basket, or, after a little practice, make one specially for the basket they are making. Before they do this, it is well to let each child have a bunch of short ends of all the coloured raffia in stock in the school, so that they can put the colours they desire together to see if they harmonise. They should also choose the crayons nearest alike to these colours with which to draw the design. It *may* be necessary to show the children very plainly that pale colours will not look well on the outside of the design, as they are lost in the self-coloured raffia. This bunch of coloured raffia is also very useful in teaching harmony of colour.

In my school, children five to six years of age make very simple designs composed of the triangle and oblong. In the next class, six to seven years of age, they generally make designs for stories.

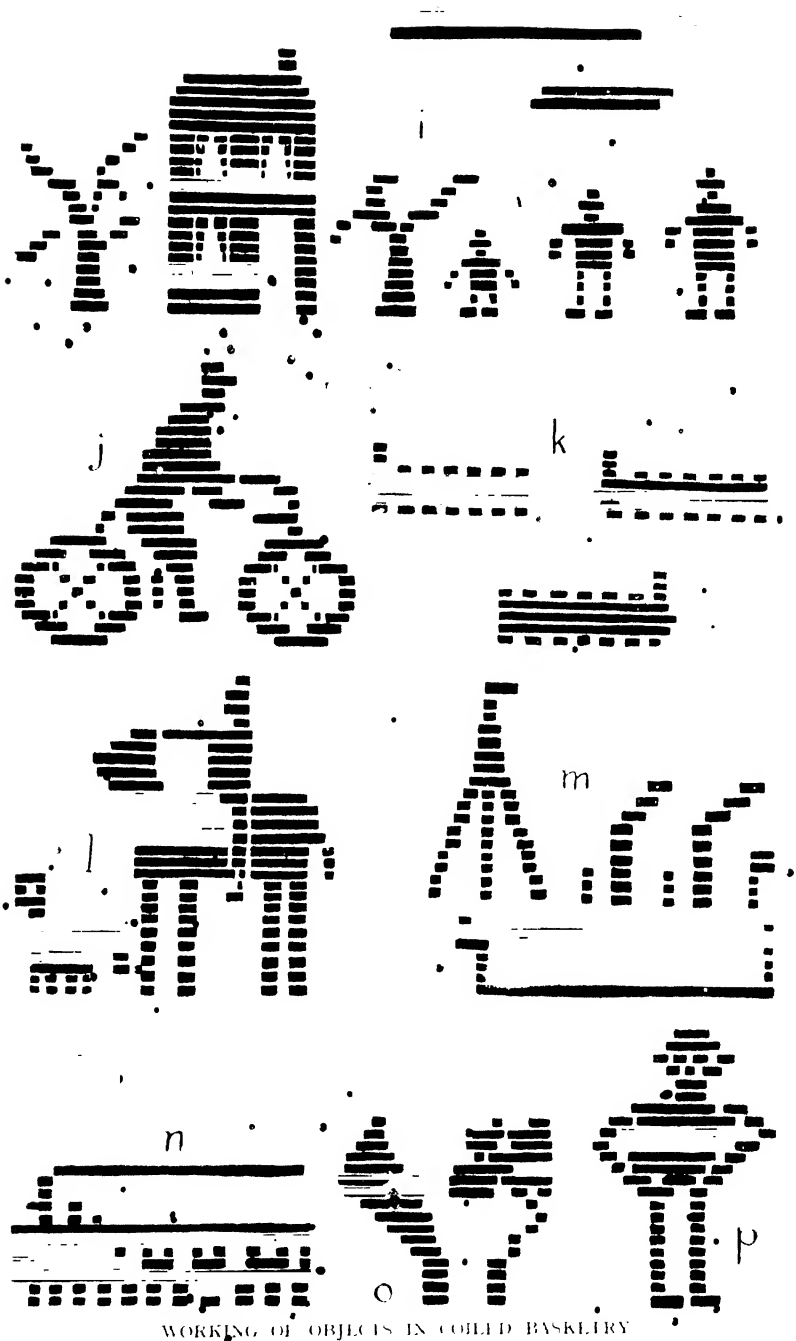
In the class of children aged seven to eight, the Pima stitch is taught, and this stitch lends itself excellently well to the depicting of stories, since much more variety is possible with it than with Lazy Squaw. In every case the choice is left to the children.

Designing with the Pima Stitch.—This also requires a few foundation principles to be taught. In Pima stitch the triangle and oblong may again be made, this time with bars of colour (Plate XXVII, Figs. 29 and 30) instead of single lines, as the stitches are made so close together that the individual stitch is lost sight of, and only a bar of colour shows in the basket. The designs may be drawn at once with coloured crayons, as the children will now be able to do without the preliminary stages.

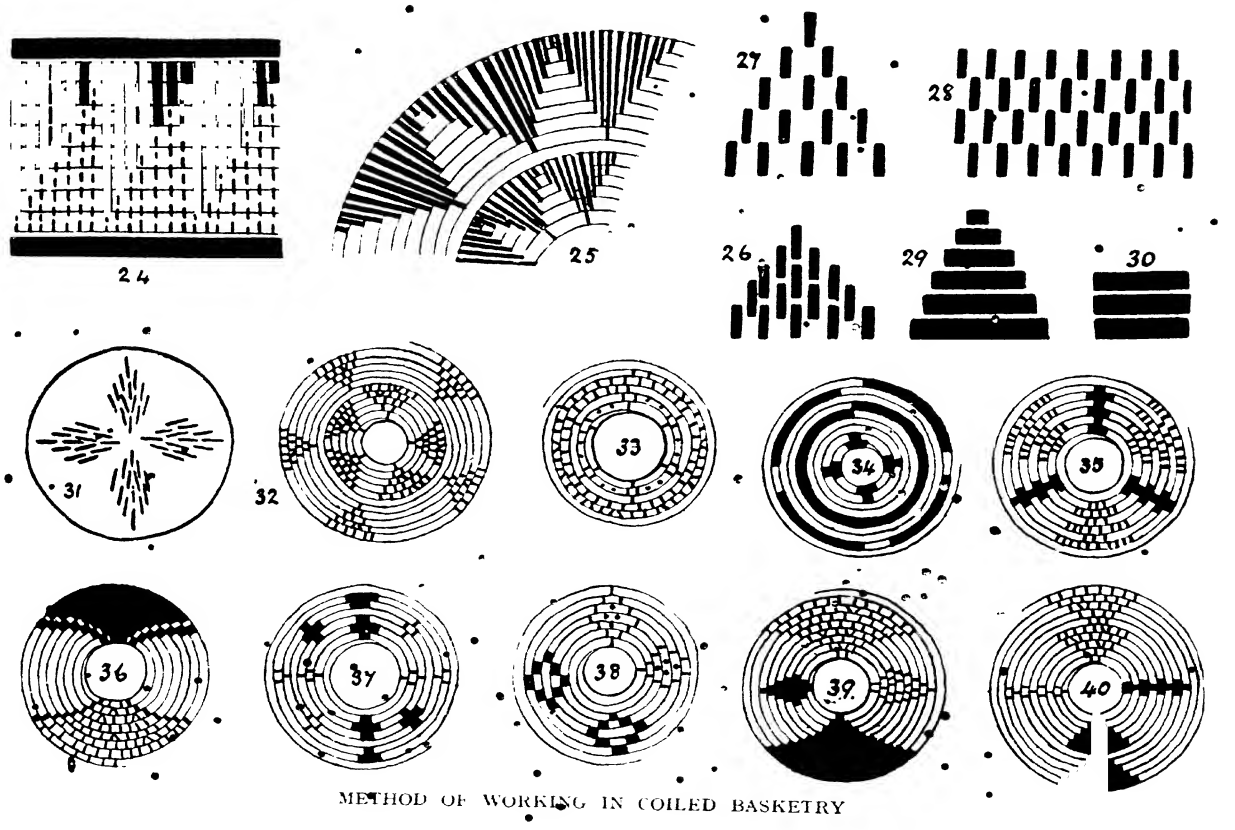
In the first year of taking original designs the children were told to make any story they liked about trees, animals, birds, or men. Plate XXV shows some of the results: *a* represents a dog watching a bird on the top of the tree; *b*, a man walking past a tree with a dog, birds flying overhead; *c*, a duck on a pond; *d*, a dog in a wood running after a rabbit; *e*, a man walking past a tree; *f*, a man going to pluck a leaf from a tree; *g*, a dog looking at a cat in a tree (I cannot see the cat); *h*, a stag.

This last year the children had no directions given to them. The designs on Plate XXVI show some of the subjects they chose: *i* represents the story of the Three Bears, the lines overhead being meant for clouds (this story also is seen on the Frontispiece in the first basket); *j*, a man on a bicycle; *k*, two lines of trains; *l*, a hunter with his dog; *m*, the *Titanic*; *n*, a train; *o*, a poppy; *p*, a man.

Designs for Lids.—As each coil is larger than the preceding one, this fact must be allowed for in planning design for lids, and a few preliminary instructions may well be given. In a lid in Lazy Squaw (Plate XXVII, Fig. 31), the child has chosen to make four diamonds. A little guidance will be needed to show how to divide the circle into four parts, and the children will also need to be told to keep the increasing *away from the edge of the diamond*. This is very important for all designs in order to keep the edges clear and distinct. Sometimes it is possible to make the coloured part without increasing at all by keeping the extra stitches in the



WORKING OF OBJECTS IN COILED BASKETRY



METHOD OF WORKING IN COILED BASKETRY

self-coloured raffia. This is always more possible when the coils grow larger as at Fig. 32.

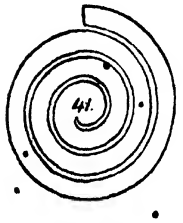
In Fig. 33, the increases should be made in the second coloured row. In Fig. 35, where the Lazy Squaw design is seen, there is a weak point. There are three stitches in the first round. In the next row there are two stitches at each side next to which no other coloured stitch will come, so they *will remain isolated and look weak.* In the fourth round there are three isolated stitches on each side. This weakness would be intensified if the stitches were made in a line by themselves.

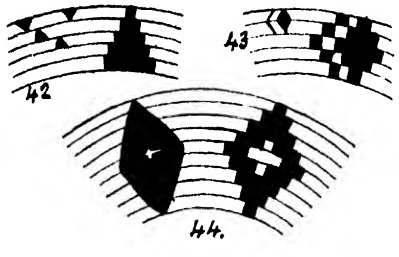
As children often wish to make a single round of colour, it must be pointed out to them that if they make the next row without colour, the coloured stitches will be little coloured marks with white stitches in between, and that if they want a line of colour round their baskets or shorter lines of colour, they must put another row of coloured stitches to fit in between the last row of stitches. These points make a great deal of difference to the beauty of the design, and if the reason be drawn from the child, or given to him if he be incapable of finding out for himself, the work is of much greater educational value.

Lids in Pima Stitch.—When the children are ready to plan a lid in this stitch (in my school in Standard I.) they are able, with a little guidance, to divide the circle into equal parts. Fig. 34 will serve well for a lesson, after which they will divide and plan for themselves. In this model the children drew their own coil and divided it into four parts and copied the first two rounds so as to form small triangles (as near as may be with such limitations of material). The teacher then said she would put two rings of colour on her drawing, and asked which they liked the better. The inner coil of colour has been made right round, the outer coil has four small breaks in it which prevent the ugly step seen in the inner one. I call it ugly, and many people agree with me, but it is seen in the native work. It is the only point in their work that I think can be improved upon. In the large baskets that they make the "step" would not impress itself so much upon the beholder, but in the small baskets it is very prominent. Even two small breaks in the coil of colour will make it *appear* as a circle.

Figs. 35 to 40, are copies of lids designed (with Pima stitch) by children aged seven to eight; but half of the design has been turned into Lazy Squaw by the teacher, in order to show how differently the designs look in the diagrams for each stitch.

If the children experience any difficulty in making the designs on the drawn coils, let them cut the coils in paper either on the lines they have drawn, or freely (Fig. 41), and then make a design on the cut coil. This will prevent them from making slanting lines because it represents more truly to them the coil in their basket, and they know that they cannot make slanting stitches in the basket. Figs. 42 to 44 show some mistakes our children made; on the right of each the teacher has drawn the correct way of expressing the design which the children wanted to be in their basket. They had not fully grasped the right way of making the diagram, though they knew quite well the general appearance that they wished to see in their baskets.

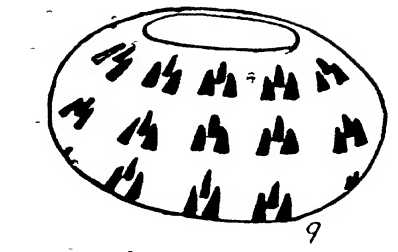




Some children reproduced part of their story in their lid, as seen in the fifth basket on the Frontispiece which shows clearly how differently the house looks in each case. As this is more difficult and a change desired, they generally make some conventional design, sometimes adding their initial or full name, as seen in the same Plate.

The Value of Designing.—Without design, coiled basketry is not of much interest to the children, or of much educational value. When design is introduced, the children work much more quickly than when making the base which needs no design. The study of design in basketry, with its many limitations, teaches a valuable lesson. The children may, and do, make mistakes in planning on paper, but in the basketry itself they cannot well make bad designs; the restrictions of material force them to make simple, bold designs, unspoilt by detail. Unconsciously this should lead

ABORIGINAL AMERICAN BASKETRY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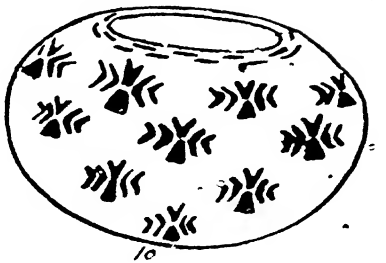
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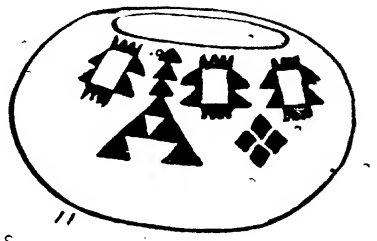
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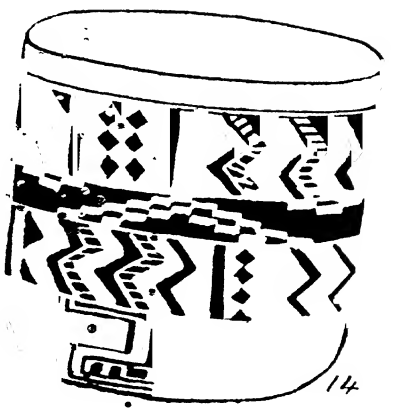
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the children to prefer and to make good designs when the limitations are not so great.

In my school, when we began to teach the children to make their own designs for embroidery on their pinafores, covers, etc., we found that the training given in basketry had laid a good foundation for the new work, the designs being well balanced, bold, and clear in most cases.

History and Use of Basketry.—In addition to what has already been said on this subject, the older children may have described to them the further use of baskets, including: (1) The storing of food, seeds, and clothes. (2) Carrying of heavy burdens in baskets suspended from the shoulders. (3) Water bottles made waterproof with gum and resin. (4) Cradles. (5) Cooking baskets. (6) Plaques for games of dice and for food. (7) Trinket baskets. (8) Bowls for food. (9) For use in marriages, dances, funerals, and religious ceremonies ("The best for the gods").

When speech was not greatly developed, ideas found expression in work, and so important events, ideals, imaginings, are embodied in baskets and messages conveyed through patterns.

Notes on Plates XXVIII and XXIX.—These plates show illustrations of basketry taken, by permission, from Professor Mason's paper on Aboriginal American Basketry, which was published in the report of the United States National Museum, Washington, in 1902.

Plate XXVIII, Nos. 1 and 4 are men's hats, and Nos. 2 and 3 are women's hats. "The colours are generally black and white only, and the designs are squares, triangles, and rude figures of canoes and seamen harpooning whales." No. 5 is a Tulare bowl, and "is a good illustration of the use of narrow parallelograms, combined in lines concentric and radial, to give expression to phenomena such as lightning." No. 6 "shows a bowl on which a diamond-shaped design has been worked with excellent effect." No. 7 shows a symbol consisting of several points meaning "clear skies, good weather." Sometimes a space is left between the points.

In No. 8 the design is made from parallelograms and other geometrical figures.

Plate XXIX, No. 10, represents the legend "Migrating," or

"When the birds leave their nests and fly away we shall move." No. 9 is an imitation of "the radial appearance of the rays of the light at sunrise." No. 11 shows "an intricate combination of squares, triangles, stepped patterns and rhombs to form the total design. The symbols relate to the different ranks or degrees in the chieftiancy of the tribe which they are entitled to receive by inheritance."

No. 12 "is a wallet made for carrying berries and other articles of food on the back—the large five-sided figures in the middle are the shark's teeth; the chevron pattern covering the shark's teeth means "Flaking of the flesh of fish into narrow strips." The small triangular figures are salmon berries cut in halves, but in this arrangement are also called "water drops." The narrow middle band is rendered "Single tying round." Below the ornamental band the cross-shaped figure represents the raven's tail."

No. 13 is "also a berry basket. The two wide bands have the same design, having a bar in the middle with its ends bifurcated —known as 'The Crossing.' The triangle in these bands stands for the salmon berry cut in halves. The middle band is tying round. The vertical design at the bottom represents "an eye" on one side, and on the other side a "shark's tooth." The five-sided figure with a re-entrant angle stands for "the Arctic tern's tail."

No. 14 is a cylindrical basket in twined weaving. The symbols in the upper band of the design are "the Spirit-voice" or the shadow of a tree "in zigzag lines and vertical rows of rhombs, which indicate the eye." Lower down comes "Tying round." The fretted pattern with three triangles inclosed in the bents like the bars of an epaulette stands for "tattooing on the back of the hand of an old man"

BOOKS FOR REFERENCE

ISABEL A. OTTY: *Indian Basket Work* (E. J. Arnold). MILDRED SWANNELL: *Coiled Basketry* (G. Philip & Sons). *The Report of the Smithsonian Institution* (The U.S. National Museum, Washington). GEORGE WHARTON JAMES: *Indian Basketry.*

LXI. CLAY MODELLING FOR SENIORS

By John Young

Senior Art Master, Glasgow High School; Instructor in Clay Modelling at the Scarborough Summer School

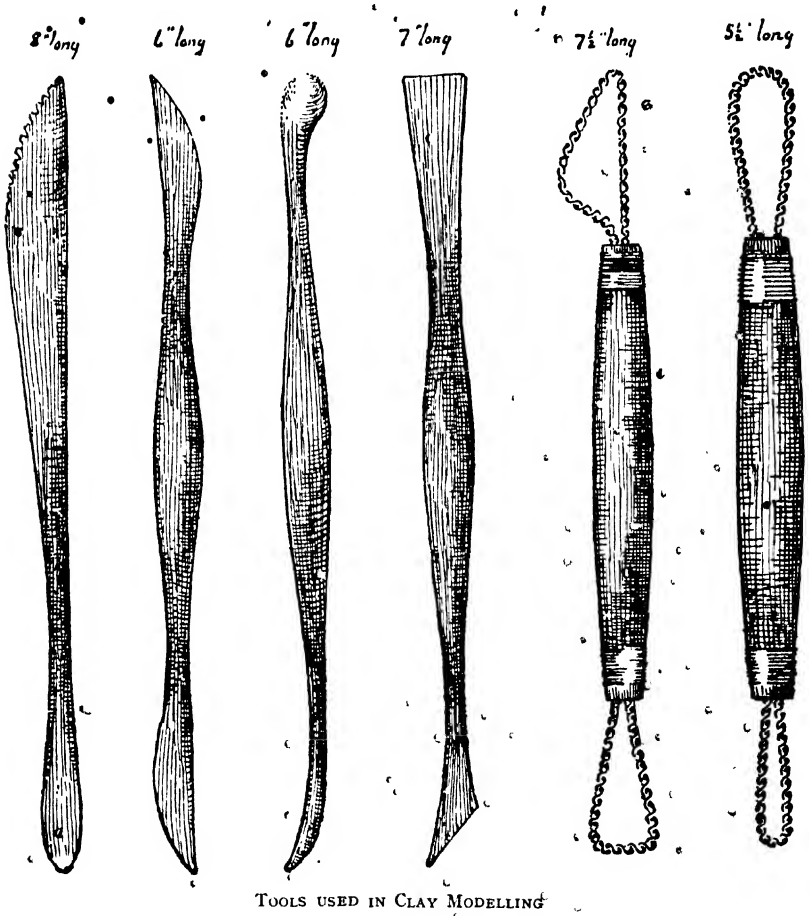
Connection with Juniors' Work.—If the reader has not already *worked through* the course given in a former volume on Modelling for Juniors, he is strongly advised to defer studying the present article until he has had an opportunity of thoroughly mastering the first part. Most, if not all, of the general advice given in the article dealing with juniors' work applies with equal force to the work of the seniors. In all practical subjects, success in the advanced stages depends largely on the acquirement of right principles and methods in the early exercises. All stages of development are relative, and it stands to reason that a class which has gained experience in simple work will not only find many difficulties smoothed away, but will certainly accomplish more and do better advanced work than one which neglects the beginnings for something more ambitious and showy.

Many art students begin their study of modelling just where this course leaves off, and that after having worked for many years at drawing and painting. This is the chief reason why so many of them take a dislike to modelling; they find it so much more difficult to make headway when working in the new medium. There is even a difficulty in cultivating the correct attitude of mind. The difference between actual forms in the round, and the appearance of these forms from a selected view-point, is a constant stumbling-block to those who have done much work in the flat. In modelling, one must see and know all sides of the object in every exercise. Undoubtedly it is the proper thing to begin imitating solid forms, in a solid material, at the same time, and in the same way, as we do when representing them by draw-

ing and painting. Difficulties of manipulation are more easily overcome when working with very simple things, and the subjects need not be so devoid of interest as to render the work a drudgery.

Those who shirk the true beginnings of any study are apt to miss the real educational influence of the whole work, and it is therefore advisable for all *beginners*, whether senior or junior, to carefully work through the first course before taking up the following series of lessons.

Equipment.—The necessary equipment for this stage will be



TOOLS USED IN CLAY MODELLING

much the same as previously given, *i.e.* the board or desk to work on, the wet sponge, good ordinary clay, and a few modelling tools. It might be advisable to extend the number of tools to, say, half a dozen, and the shapes illustrated on p. 222 are recommended. The use of calipers or other occasional tools may be demonstrated by the teacher when the opportunity occurs, but there is no necessity for the student to have these for himself.

When the exercises get more elaborate it will be increasingly difficult to finish a study at one sitting, and this may necessitate keeping the clay moist from one lesson to another until the work is complete. The best plan to overcome this difficulty is to have a zinc-lined cupboard with shelves to receive the class work. In such a cupboard, if the lid or door is kept closed, no evaporation takes place, consequently the clay remains as you leave it, and no further attention to the work is required. In an ordinary press, however, the moisture rapidly leaves the clay, and it becomes hard and may probably crack in pieces. The work, of course, is lost, unless it has been carefully covered with a moist woollen cloth and sprayed with water from time to time to make up for the natural evaporation which must take place. This latter method, though involving more trouble, is quite common, and is considered no drawback in many schools where excellent work is done.

Scale of Work.—It is recommended that the work should, as a rule, be done on a scale equal to that of the original model. This will, of course, regulate the amount of clay to be supplied. It would be a great mistake, however, not to vary this rule at times, and give practice in working to a scale larger or smaller than that of the natural example. There is no greater danger in any of the practical subjects than that of falling into a groove, and a teacher must avoid this pitfall by changing the scale of work, or occasionally to allow the children to make their own choice: the choice to be deliberately made before commencing work.

Material for Study.—With regard to the subject-matter for study there are two important points which must be kept in view: (*a*) whatever is used should be appropriate to the stage in which it is presented; and (*b*) it should be perfectly graded.

It is the duty of a teacher out of his wider knowledge and experience to find out the capabilities of his class, to select from the whole range of his subject the proper material and environment which will stimulate and interest the pupils, and to see that every effort leads up to and forms an understructure on which to build the more difficult and elaborate work of the higher stages. There must be no sudden jump, or inconsistent break in the continuity of progress towards the desired goal, and one essential to that end is easy and thorough gradation of the exercises.

The whole method of work in manual training should encourage the self-active interests of the class. Place a special value on originality and independence of thought in working out the exercises, so long as general principles are not violated. To develop this, it will be found a good plan to repeat certain lessons as memory tests, and occasionally to ask for the representation of an idea. That is to say, instead of always placing the real model in front of a pupil, rather talk about it, and call up an image of it in his mind, then ask him to give expression to his own thought in clay. There is a wealth of material suitable for such lessons, as well as for the whole work of this stage. A teacher must exercise great care in his selection of models to choose those which are interesting and beautiful in form and proportion.

The Present Scheme.—The examples illustrating the present article do not form a scheme or graded course suitable for any school class. They are selected type lessons which it is hoped may indicate the source from which suitable models may be obtained. It cannot be too strongly urged upon teachers that they must eschew the ready-made set of lessons, for, to put it strongly, what is meat to one man may be poison to another, in this as in anything else. The illustrations given here may also be helpful in explaining the method and style of treatment which experience has proved to be suitable for work in large classes.

The lessons illustrated on Plate XXX, Figs. 1, 2, and 3 may be looked upon, more or less, as repetitions of the junior work; while Figs. 4, 5, and 6, 7 (Plate XXXI), are more appropriate to the work of the senior classes. The folding-back of the banana

FIG. 1.—THE BANANA. FINISHED EXERCISE.
FIG. 2.—THE TURNIP. UPPER HALF UNFINISHED.
FIG. 3.—MUSHROOMS. FINISHED EXERCISE.
FIG. 4.—SPRAY, ROSE. LOWER HALF LEFT IN THE ROUGH, SHOWING FIRST STAGE.
FIG. 5.—SPRAY, IVY. TOP LEAF ONLY FINISHED.

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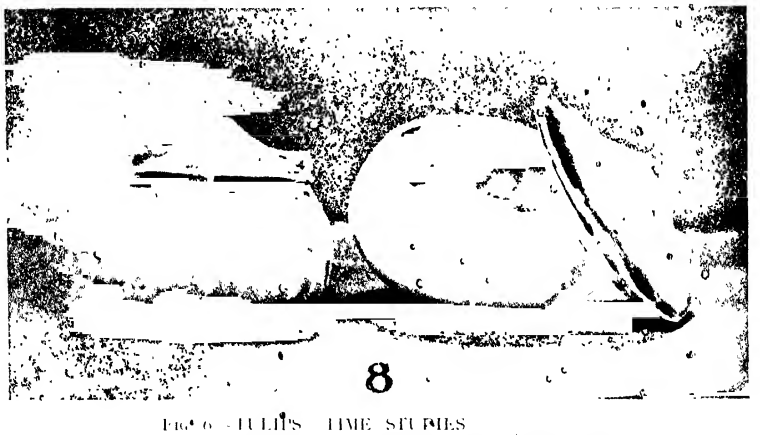

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FIG. 6.—TULIPS. TIME STUDIES.
FIG. 7.—DAFFODIL. MEMORY AND TIME STUDY.
FIG. 8.—POTTERY. PART OF A TOILET SET.
FIGS. 9 AND 10.—POTTERY. ORIGINAL DESIGNS FOR SMALL VASES, ETC.

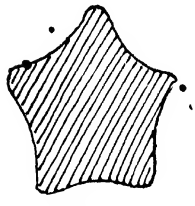
skin, the inclusion of two mushrooms in one exercise, and the retention of tops and rootlets in the turnip makes the first three lessons just a little beyond what is asked from junior classes.

Method of Working.—All of these seven models and any of a similar nature would be worked in the manner described under "Fruit Forms in the Junior Course." Briefly stated, that is as follows: (1) Moisten the surface of the board, and on it model a *slab* (Vol. III, page 105) about ½ in. in thickness and at least 1 in. longer and broader than the length and breadth of the chosen model. (2) Roughly model in the hand a solid piece of clay as near as possible in size and shape to that of the model. Place this effort and the model side by side, and test the shape from at least six points of view (Vol. III, page 103). (3) After correction and indication of the principal details, *e.g.* in the banana the ridges running from end to end and the shape of the ends themselves, place the clay model on the slab, in the desired position, and work these two parts into one solid piece. (4) Finish the whole of the exposed surface in every detail.

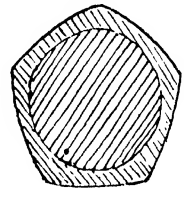
It may be pointed out for the guidance of any one who is to teach this subject that the common failure in all exercises similar to these lies in neglecting or doing very carelessly steps 2 and 3. In modelling the piece, the glamour of detail arrests the attention and prevents that thorough attempt which should be made to have, first of all, a true rendering of the general form. It must be constantly reiterated that details are of no use, if the construction is not just right. They will not hold together, and do not make a unity. It takes time and repeated effort to fully appreciate the value of rigidly disregarding parts, until the general mass has been modelled correctly and is ready to receive further elaboration.

Again, in the third step, one is pretty sure to find the average boy and girl quite satisfied to observe the length and breadth of the banana, then proceed to roll out carelessly a lump of clay that might with equal truth represent a sausage, and is just as near to looking like a radish or a carrot. They will further take liberties with this poor attempt, and half bury it in the slab until it loses all pretence of being an imitation of a solid model in the round.

It is just here that the principles of method which apply all through the study and which were given at the beginning of the junior course must be put into operation. First, there must be true and thorough *observation*, before the attempt is made to represent any form, and very careful testing by *comparison* after the attempt has been made. When the general mass is right, it should be pointed out that although there is a slight family resemblance between the sausage and the banana, yet when seen rightly, they each have unmistakable characteristics of their own. In this instance the ridges on the banana form the first detail, and these should be carefully *drawn*—not merely scratched upon the clay surface with a pencil or sharp tool, but carefully modelled with finger and thumb in the usual way—upon the mass and the planes between them truly modelled. They need not be finely done but should be true as far as they go.



WRONG



RIGHT.

The first result likely to occur with the rank and file after explaining a point like this is the fault of exaggeration. The ridges will be much enarged, and the planes between made concave, resulting in a form which would give a section something like the above sketches. To correct this tendency, a diagram drawn upon the blackboard will be of the greatest service. One of the models should also be cut across, when it will be seen that the planes are generally convex, and the ridges are merely the stoppage of the round planes; there is nothing in the nature of a vein or projecting arris.

Very careful instruction is also needed for the next point. I have noted before how easy a thing it is to spoil an hour's work in a second's careless handling. It is always necessary to remind young pupils that it has cost them something in time and effort to get the clay mass just right in size and shape, and that it must therefore be handled carefully and treated with a

certain measure of respect. To fix it in position, it should be lightly placed upon the clay slab, when its poise and set should be tested again from at least five points of view. When this is satisfactory, the connection is made by pushing in below it small rolls of clay. With the help of a modelling tool these should be lightly but thoroughly packed, and worked half into the slab and half into the clay model. It is then time to think of cutting the skin, and of finishing the whole of the exposed surface.

In preparing this, do not make the mistake of leaving the piece of skin sticking up vertically and expect to imitate it in this position by a thin web of clay. Remember, clay has its limitations, and this is one thing it will be found very difficult to do in this medium. Press the skin well back and down as in the example, so that it is supported on the slab or banana, then proceed to model its top surface. Similar difficulties to these crop up in the other examples, but if once they are thoroughly mastered in any one, it should not pass the ingenuity of an ordinary boy or girl to get over the same sort of thing in a new model.

When all the parts have been truly modelled, as regards size and position, we must then turn our attention to the surface details. The texture of the core is a contrast to the smoother surface of the skin. The slab can also be made absolutely smooth and its edges neatly trimmed. In doing this modelling tools are necessary, and for toning down the small markings which may have been made too strong, or to get into small out-of-the-way corners, a hog-hair brush (such as is used for oil painting) will be found useful. The slab should be made smooth by large sweeps of the ruler, previously made moist and clean. The flat of a broad modelling tool is equally suitable, of course. See that the edges are kept nice and square.

Repetition.—This is necessary to enforce and make sure of any lesson; but in modelling, repetition need not be the dull, soul-killing thing that it sometimes is in other subjects. The first seven examples given present no other difficulties than those enumerated here, and the woods and fields, the orchard and the garden, offer a bountiful supply of similar material from which to pick and choose. In towns the fruiterers and the market gardeners make up to a certain extent, as they are always ready

to do their best if you let them know your needs. In the infinite variety of flowers, fruits, and vegetables there are multitudes of fascinating forms which are admirably suited for modelling lessons. Best of all, most of them admit of much variation to suit the growing capacities of the children, for if the juniors have enough to do in modelling an apple, yet the seniors may repeat this same lesson, doing the apple with leaf and branch; and if a pea pod is sufficient for young children, yet the seniors may repeat it, opening the pod to show the row of peas inside, or have the pod supplied with leaves and a portion of the stem attached.

Roots such as the turnip, leek, radish, etc., may now be taken whole, just as they come from the ground, and sprays should take the place of the simple leaf, flower, or fruit. The teacher must make a judicious selection, providing interest and variety, and with a gradually increasing pitch of difficulty as the lessons proceed. It is true, of course, that this source of supply is available only during the spring and autumn, so that one must plan out his course to take this type of work when the models are in season; but the material is so interesting in itself and the choice so wide and varied, that it is not a difficult matter to arrange a series of lessons to suit the needs of a class at any stage of its progress.

Time Studies.—I should like to call special attention to the type of exercise illustrated by Figs. 6 and 7, Plate XXXI. These models were made by senior boys in the short space of a single period each, of something under forty minutes. In the first case the model was retained by the pupil, after discussion, and it was simply then a case of working against time. In Fig. 7, after about five minutes for discussion and observation, the flower was put away out of sight and the work done entirely from memory. When these exercises are first tried the result is apt to be rather discouraging. One will find, however, that if persisted in, they yield as good results as the ordinary lesson. As a training in self-reliance and accuracy of memorising impressions they are invaluable. Being time studies they also encourage directness in dealing with nature forms, which are too apt to change even within the period of a single lesson.

Pottery and Fashioned Objects.—When specimens from the vegetable world are no longer available, or when a change is con-

sidered desirable, there are other sources of supply. In the junior course, a beginning was made in the fabrication of actual things which are usually made of clay, and also in imitating the form of other fashioned articles in any material. Though these models do not have the same grace and beauty of proportion, or that subtle blending of planes which nature's handiwork ever exhibits, yet man's struggle with material, to shape and fashion it to his own ends, has evolved a teeming variety of forms that almost rivals that of nature itself. Many of them are admirably suited to our purpose, and every one illustrates and enforces that great lesson which lies at the root of all manual teaching, namely, the inseparable union of art and industry. The things we wear, and everything we use, be it weapon, implement, or article of adornment; our dwelling-houses and vehicles of locomotion; yea, even much of what we eat, and a thousand other objects, are all designed and formed into shapes that are fit and pleasing to the eye. A teacher of modelling can here find a source of inspiration almost as fruitful as that of nature. If the models are properly selected and the lessons given in the right spirit, both method and matter will make a strong appeal to the interests of the children.

Take, for instance, the series illustrated on Plate XXXI, Figs. 8, 9, 10, and 11 (Plate XXXII). The exercise shown at Fig. 8 is to make a small hair-tidy or pomade-box for the dressing-table. The method of making small dishes of this sort was fully described in the Junior Course, and the step in advance included here is that the dish, (whatever its shape may be), must be provided with a lid of some kind. Encourage the pupils to experiment with these simple clay shapes, so that they are not always merely copying a given form, but by design (or it may be accident) they will evolve, discover, or create new and original shapes of their own.

Directions for proceeding with this exercise were given in the former article, but may be briefly restated here. It is possible that the results of these lessons may be submitted to the ordeal of the furnace, in order to render them permanent: the first care is to see the clay thoroughly "wedged" (*i.e.* made free by thorough kneading of included air bubbles), made homogeneous, and freed from any grit or foreign substance. Do not build up

the form in tiny pieces, as one does in the ordinary modellin lesson, but try to select a mass just large enough for the require ments, and work this into the shape desired. First roll the cla into a ball, which flatten to a round disc, by gently tapping o the dry board or table. Let this disc be about ¾ in. thick, an fairly round. Hollow it by a circular motion of the wet thumb while gently pressing the centre of the top downwards. Cease hollowing when the thickness of the clay mass has been reduce to about ¼ in., and then, working from the centre outwards an upwards, press the clay between finger and thumb until the whol wall is about ¼ in. in thickness. See that there is no splitting o the upper edge and keep the inside as smooth and round as possible Consider then what shall be its ultimate shape. Do all this wor on a dry board, so that the mass of clay can be shifted abou lifted to the eye level, or handled in any way.

Proceed in the same manner with the making of the lid; an when it is found that the two fit roughly, they should be laid asid to dry and harden a little. When the clay has reached what known as the "leather stage" it can still be modelled and shaped and is much easier to handle. It should now be further finishe and the lid fitted exactly. After drying for several days it ca again be taken up and further finished in the usual way b trimming and scraping with a penknife, and polishing the whol surface with sandpaper.

Figs. 9 and 10 on Plate XXXI illustrate a collection of sma vases and pots made during one session by a student who devote the whole of his modelling time to this work. Much of their charm lay in the colour, and this is, of course, lost in translation to blac and white, but they may serve as suggestions for further exper ment on the part of teachers. As a modelling exercise pure an simple, this makes a very interesting series of lessons, but the fu benefit to be derived from pottery work is experienced only b those who make the attempt to carry out the whole process.

The small candlestick illustrated on Plate XXXII, Fig. 11, is favourite exercise with children. In taking this lesson the teache will find it very necessary to use his restraining influence to mak the little workers take things quietly and deliberately, for th common pitfall is over-ambition and eagerness to see the thin

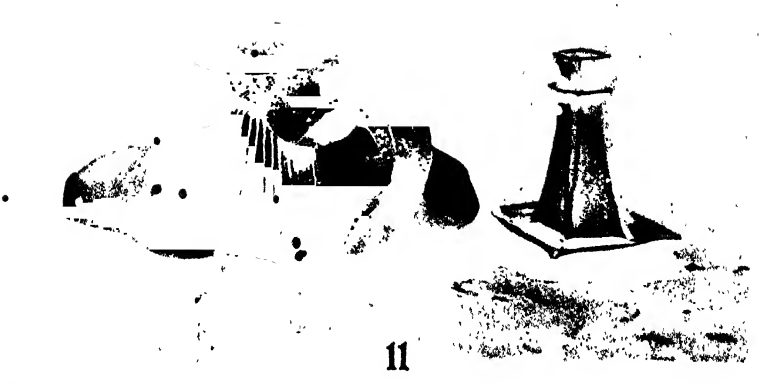


FIG. 11.—POTTERY CANDLESTICKS. THE RIGHT ONE IS GLAZED AND FIXED

FIG. 12.—TILE. ORIGINAL DESIGN, BASED ON TULIP STUDY FIG. 7. LEFT SIDE SHOWS FIRST STAGE. THE RIGHT SHOWS COMPLETED DESIGN

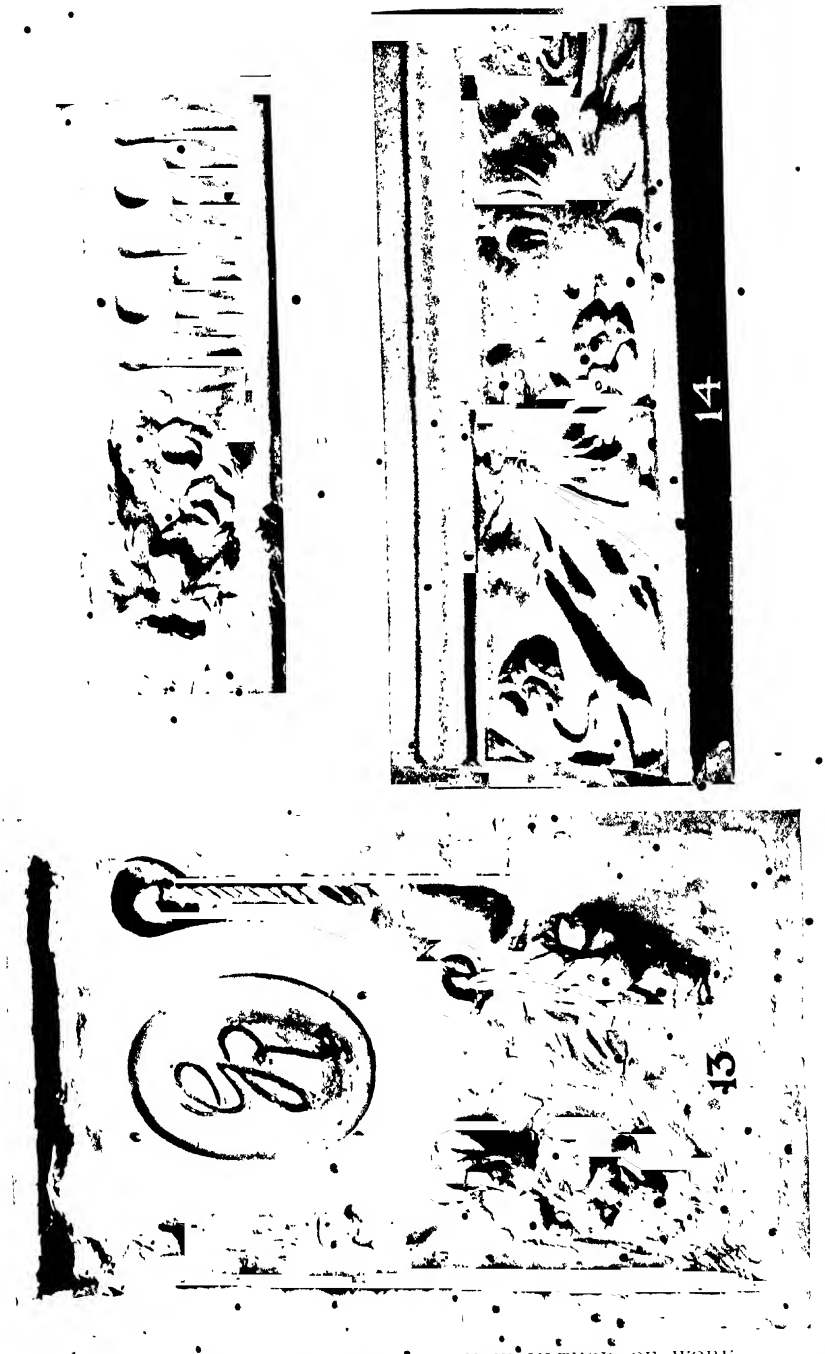


FIG. 13.—PANEL, UNFINISHED TO SHOW METHOD OF WORK

FIG. 14.—MOULDINGS. UPPER FIGURE SHOWS VARIOUS STAGES OF WORK FROM LEFT TO RIGHT. THE LOWER EXERCISE IS FROM A CAST

complete. Hurry seldom pays in art work, and it generally leads to disaster. The steps in making a candlestick are as follows: First, make the saucer-like under-portion by the same method as for the small round dish. Be careful not to raise the edge too high and to have the thickness equal all over. Make sure of each step before proceeding with the next. Second, work a small piece of clay over the end of one of the fingers of the left hand, just like a thimble. This piece, when of the right depth and diameter, will form the under-portion of the stock. Shape it and place the open end exactly over the centre of the base, then join and work the two pieces into one with the modelling tool.

The smaller top piece is now shaped, placed, and joined in exactly the same way. This time the open end is uppermost; and the hollow or socket for the candle should be made about $\frac{1}{8}$ in. larger in diameter than that of an ordinary candle. This allows for the natural shrinkage of the clay in drying and firing. If a handle is desired, it should now be shaped from a thin roll of clay, and fixed to the body in the same way as the other pieces were joined. Lastly, pinch the edges of the base into any fanciful shape desired and put it carefully away on a shelf to dry. When quite hard, white, and dry, cut away the centre of the base just under the stock, making the under-side open and hollow right up to the second joining. Trim off all irregularities with a penknife and polish the whole surface with fine sandpaper.

Modelling in Low Relief.—Coming to the examples shown on Plate XXXII, Fig. 12, and 13, on Plate XXXIII, we have another phase of this imaginative work illustrated, namely, the ornamentation or decoration of a flat surface by modelling forms in low relief. This system of decoration is often applied to pottery, as well as to the numerous curved surfaces of architectural and other constructions. It is easiest, however, to begin with flat things such as a tile, a coin or medal, an escutcheon or shield, or any small panel.

Modelling in low relief is a method of work which lies between drawing on a flat surface and true modelling. It is more difficult than work in the round, where one deals with realities, but early exercises are not beyond the ability of school-children. The forms are sunk into the clay surface, or only slightly raised above it,

and they may be purely conventional and decorative, or they may be highly imitative—in the latter case, the modelling, though comparatively flat, is intended to convey the impression of complete roundness. The two sides of a shilling illustrate very well the two types of work done in this method. The modelling on both sides is but slightly raised from the surface of the coin, one giving a true portrait of the King, while the other shows some heraldic device, date, and lettering, arranged in the first place to proclaim the value and origin of the coin, but also as a scheme of surface decoration.

The first essential in low-relief decoration is to give a sense of enrichment to what would otherwise be a plain, bald, flat surface. In imitative work the hollows and rounded additions must be blended as in the natural example, though the total height of the modelling may be only a fraction of that of the real thing, and the difficulty is, to preserve the same ratio or relative height all through the exercise. In more conventional work the units of design, whether merely tool marks, geometric forms, or abstractions from natural specimens, must be arranged in some orderly sequence that will give a harmonious division of the space, and a pleasing combination of lights, shades, and shadows.

The square surface of a 6-inch tile provides a very good field for the first few exercises, and it may also be used for very ambitious work. On floor tiles the amount of relief for the decoration should be reduced to a minimum; on wall tiles and those which will occupy more decorative positions the relief may be increased. Do not imagine, however, that the measure of relief is in itself a merit or demerit; it affects the quality of the work not one jot. The details on a newly minted coin stand out as clear and sharp as the details of a boldly carved panel in wood or stone. To settle the amount of relief is merely a question of making the work to harmonise with its ultimate surroundings and fit for its purpose. When the relief is slight, the result may be readily attained by adding thin layers of clay upon the slab surface, working the forms with a modelling tool, and depressing the surplus into the slab (see Fig. 12, left side, Plate XXXII). If the relief is bolder, it may be built up with the slab, or work may be commenced upon a slab thick enough to enable one to

cut into it, removing the clay that is not wanted, and leaving the desired forms standing (see Plate XXXIII, Fig. 13, left side). Either way is right, but, generally speaking, this latter is the method proper to carving, and does not seem so fitted for work in a non-resisting material like clay. As a matter of fact the worker must use his own discretion as to which method will most easily give him the result he desires to attain; very often the work necessitates a mixture of both.

Fig. 14 gives further scope for design and constructive work; it also provides a range of very useful lessons in modelling. Begin by modelling a slab on the board, make it about 4 in. deep by 10 in. in length (Fig. 14*a*). Cut off, and lift a strip from the top of this slab about 1½ in. deep. Place it at right angles to the rest, forming the projection of the moulding. Fill in the angular space thus formed, and work the surface to any desired form in section along the whole length, converting the slab into a short length of moulding.

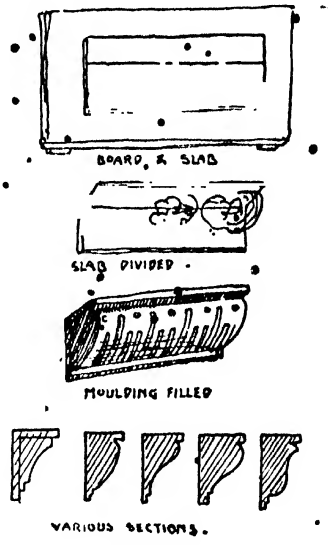


FIG. 14a.

Then proceed to decorate this rounded surface by modelling some simple unit of design, and repeat it at properly considered intervals. At first these decorative units should not be elaborate, but a repeat of the simplest stroke with the wet finger-point is enough to illustrate the principle of the thing (see first example on Plate XXXIII, Fig. 14. When these simple lengths can be done with anything like success, try the return moulding with its corner ornament as shown in the example.

Variety of Examples Necessary.—Whether these lessons are taken with a view to develop original designing, or as imitative lessons in which the pupil copies faithfully every detail of some specimen given to him, it is equally important that, at first, a large variety of examples should be shown to and discussed

FIG. 19.—UNFINISHED STUDY OF A FISH.

FIG. 20.—UNFINISHED STUDY OF A LOBSTER.

FIG. 21.—POTTERY: SMALL PAPERWEIGHT MODELLED FROM A STUFFED CORMORANT.

FIG. 22.—TWO PARTIALLY FINISHED STUDIES FROM A SMALL TANAGRA FIGURE; THE CENTRE ONE IS THE ORIGINAL CAST.

much service in the cause of humanity, makes a lesson of great interest, and one which tests the power of observation almost as much as if the model were the human foot itself. It admits of much repetition when a sabot, sandal, or shoe takes its place and provides that little spice of variety which practically makes it a new exercise. Other objects of wearing apparel may suggest themselves, and historical curios or specimens of minerals provide matter for other studies of this same character.

The method of setting about these studies does not vary much, and would follow in lines similar to those given for previous lessons. As a rule, it is a case of *building up* the general mass first by the gradual addition of small pieces of clay. Remember to work *all round* the model—a little while at one part, then pass on to the other side, and continually *test* your efforts from all points of view. Do not begin any detail till the mass is correct, for the excellence of good modelling often depends very largely on work which is not seen, yet which has been correctly and conscientiously formed.

Most of the work illustrated has been left purposely in an unfinished state in order to give a better suggestion of how it has been done.

The last group of lessons illustrated on Plate XXXV, Figs. 19 and 22, is varied, interesting, and suggestive of wide fields from which many good lessons may be drawn. As an exercise for the higher pupils of a senior class, those who can work quickly and practically finish a study at one sitting, the fish (Fig. 19) and shell-fish (Fig. 20) provide many fine examples. Stuffed specimens of fish, birds, small animals, and heads of deer, sheep, dogs, etc., etc., do very well, but, even at its best, the taxidermist's art is but a poor substitute for the real combination of bone, muscle, and skin.

The method of work described for the banana exercise would suit very well for this series. The slab is prepared first, about 1 in. larger than the specimen to be copied. On this lightly scratch the outline of the general form and its principal parts. Model roughly the masses and place in position on the slab. When all has been thoroughly tested and found correct, join the pieces, and with the help of modelling tools tackle the details, surface texture, and general finish.

Regarding the last two illustrations (Figs. 21 and 22) given here, they are typical of a set of exercises that give great pleasure to pupils of all ages, while they form a direct link with elementary modelling and the higher work of the sculptor, who deals chiefly with the study of living animals and the human figure. Naturally they will be very difficult to do, but they are all the more valuable on that account, as a training in observation. It is not advisable in school exercises to use any *armature* or elaborate wire skeleton on which to build these efforts. This is usual with the professional where the work is done on a large scale and a cast is taken from it directly it is finished.

The method used here is to build a mass of clay to correct measurements (rather under than over the size), put it roughly into shape, and lay aside until it gets stiff. Do not let it get hard, but only to that state where it is still possible to model and change the shape of the piece without its breaking off. On this it will be found possible to do the real modelling. When finished, it will simply dry and contract without breaking up, after which it may be fired in a kiln or put into a cupboard as finished work. This could not be done if any wooden or iron support had been used. The clay contracts in drying, but the supports do not, and the result is certain splitting and crumbling away of all the smaller parts from the larger mass.

Great care must be exercised in selecting specimens of this kind, as there is an enormous mass of very bad, cheap stuff on the market; but good specimens may be found, and they are not always the dearest. The Cheshire and Liberty cat pin-cushions, china pin-trays and flower-holders, and grotesque match-holders, are, many of them, both quaint and well modelled. The Japanese figure and animal work in clay and cheap metal is excellent, the small casts taken from Egyptian and other idols, and the set of Greek Tanagra figures of which my last illustration is one, can be had very cheaply. All of these make lessons which are not only admirable from the point of view of technique, but they are bound to rouse an interest in the historic examples of some of the world's best work in sculpture and modelling.

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